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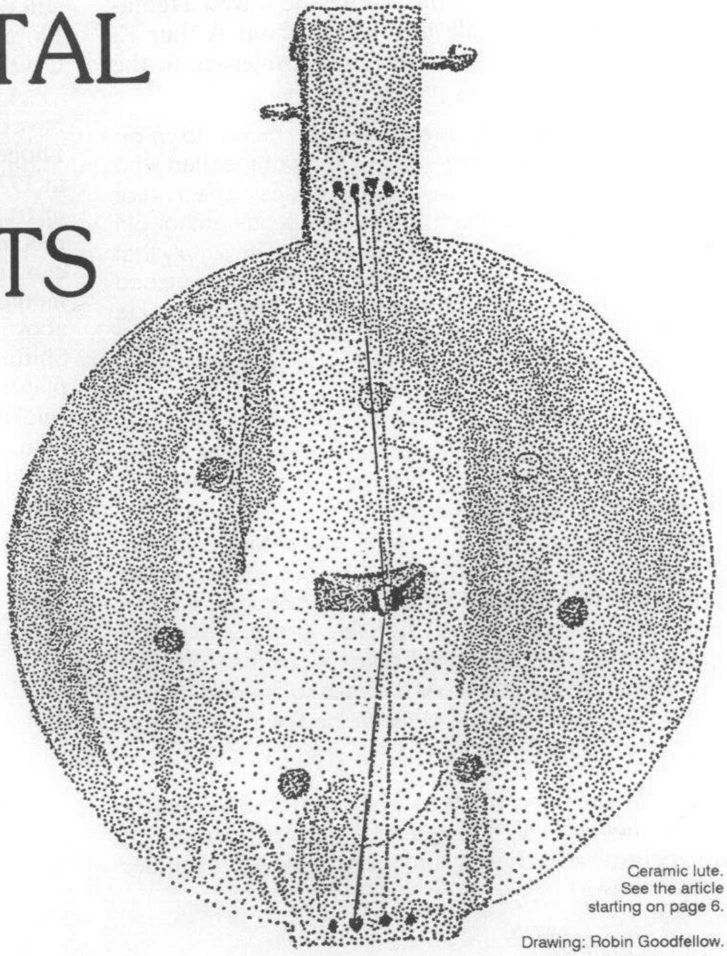
FOR THE DESIGN, CONSTRUCTION AND ENJOYMENT OF UNUSUAL SOUND SOURCES

EXPERIMENTAL MUSICAL INSTRUMENTS



Ceramic lute.
See the article starting on page 6.

Drawing: Robin Goodfellow.

AND FURTHERMORE ..

Synaesthesia, as the word is most often used in the context of contemporary arts, refers to the association of perceptions of one of the senses with the sensations of another. In this issue of **Experimental Musical Instuments** we will look at aspects of the crossover between sound and image, through a compendium of the lore of *color organs*, brought to us by Kenneth Peacock. His article starts below on this page. Also in this issue we have reports from some builders of extraordinarily beautiful instruments, including Ferdinand Försch, maker of elegant, sculptural constructions of copper, aluminum and brass; and Ragnar Naess, who, in conjunction with the composer Tan Dun, has made an orchestra of finely-crafted ceramic instruments. We have as well a report from Peter Whitehead on some instruments of common materials/uncommon sounds, plus the completion of our 3-part series on conjoined string systems, and the usual complement of additional useful odds and ends.

We turn now to the color organs.

IN THIS ISSUE

FAMOUS EARLY COLOR ORGANS

by Kenneth Peacock

INTRODUCTION

Many readers of **Experimental Musical Instruments** would agree that musical connotations are intended by painters who have referred to their paintings as "compositions." And multi-media artists today commonly use the term as well. Specific connections to music can be seen in such paintings as Mondrian's "Broadway Boogie-Woogie," Kupka's "Fugue in Red and Blue," or "Symphony in Violet" by Albert Gleizes. Actually, the issue of musical

(continued on page 17)

YOUR REPRINT OF EDWIN TEALE'S ARTICLE "Ten-Foot Fiddles and Two-Story Harps" in the April issue solved a tantalizing mystery for me. Teale also wrote about Arthur K. Ferris' instruments in his **Autumn Across America**, in the following frustratingly sketchy paragraph:

An editor had sent me from New York to a chicken farm on the edge of a small New Jersey village. One of the men who fed poultry there was reported to have the oddest collection of musical instruments on earth. I found him a patriarchal old gentleman with mild blue eyes. He explained quite simply that he saw visions and that once, years before, he had watched 126 angels, each playing a different musical instrument. He had set out to reproduce on earth all the instruments he had seen. We examined a score or more he had completed: fiddles with three necks instead of one, a harp so huge it could be played from a second-story window, violins with crook necks and extra strings, harps and fiddles combined. All of his instruments had been turned out with no special training and with the use of ordinary carpenter tools. Yet one of his smaller violins, he told me, because of its sweetness of tone had sold for $500. Afterwards I checked with the owner and found this was true. The wood that went into all these instruments came from a common lumber yard. But the instrument maker believed he was guided to certain boards, ones that rang like a bell when he thumped them. All the resonance and beauty of tone in the finished product, he maintained, was inherent in the fibers of the wood.

So thanks for the opportunity to finally see these wonderful instruments (though Teale's longer article omits reference to the visionary inspiration Ferris confesses to above). I wonder if any have survived?

Hal Rammel

A FURTHER CONTRIBUTION to the discussion of cat organs has just come to my attention. In a story written in 1893 by Jules Verne, "Mr. Ray Sharp and Miss Me Flat", a mysterious organist and builder plans to add an extra register of children's voices to a church organ:

"Why not? They've been able to make a piano with cats, cats chosen because of the yowl they gave when somebody pinched their tails! A cat piano, a cat piano!" he repeated. We began to laugh, without really understanding whether he was speaking seriously or not. But later on I learned that he had told the truth when he had spoken about a piano of cats which miaowed when their tails were pinched by machinery. Good Lord! What won't they invent next!

Yet another postscript to my earlier report on two extended pianos devised between 1910 and 1922 by Georges Cloetens [EMI Vol. IV #2 and Vol V #3]: it concerned the luthéal, featured in two works by Ravel, and the somewhat different orphéal, which, however, is named on a restored instrument that is clearly a luthéal. Delving into French patents from the early 1920s recently I came across one for pneumatically-powered musical instruments by a French company called Orphéal. This was presumably a company originally set up to market Cloetens' earlier Orphéal, but it still does not explain the apparent misnaming of a modified Pleyel piano on which also appears as manufacturer the name Cavaillé- Coll.

A quick response to the new theme of conjoined strings. I have used a similar approach with springs, a subject on which I hope to offer an article to EMI in the next few months. And in 1975 I made an experimental model of a conjoined wind instrument, the Double Single-Reed Pipe, consisting of a long rectangular free reed cut from thin brass tied down at its center with thread (which is not the most reliable fixing method, but perhaps the most effective one in this instance) above a slot cut lengthways in the wall of a thin bamboo tube. Shifting one's mouth to one side or the other enables the player to activate either each half of the reed separately (making a single reed that can involve the full length of the tube by keeping the non-sounding side of the reed within the mouth cavity) or both halves together, so that the two sections of the tube are conjoined. The latter produces quite a racket, and at the time did not seem to deserve further research.

Hugh Davies

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SUBMISSIONS: Experimental Musical Instruments welcomes submissions of articles relating to new or unusual musical instruments. A query letter or phone call is suggested before sending articles. Include a return envelope with submissions.

THE NEW EMI ARRIVED TODAY. Great! I have already read through most of it, typical behavior for EMI but highly unusual generally speaking.

I was quite pleased to see an in-depth review of the latest issue of **Musicworks**. I have been a subscriber to it for a few years now and have been impressed by its consistent high quality.

The article on computer control for acoustic instruments is an absolute hoot. This article, not surprisingly, is of great interest to me as it's on a subject i've worked on a bit myself. One issue i didn't see discussed, though, is the control of extraneous acoustic noise made by the interface mechanisms, a problem i've noticed is not new to the genre of automatic musical instruments. I have a few commercial recordings of player piano transcriptions where the sounds made by the pneumatics are softly audible during quiet passages. [*The new EMI tape (Vol. VI) includes some automatic instrument recordings which illustrate this as well. The original out-of-print vinyl recording from which the selections were taken includes this note on the cover: "There has been no effort to filter out the mechanical noises produced by the movement of parts, as we believe these are part of the overall sound." – ed.*] I encountered a similar problem with my Pandemonium project, where the sounds of the solenoid pistons sliding in and out of the solenoid barrels were clearly audible. In the context of the Pandemonium project this wasn't an issue, but would be for more "refined", non-ad-hoc auto-instruments. I thought of quieting the mechanism by wrapping the solenoid pistons with very thin pieces of Teflon or Delrin sheeting, but then there's the problem of adhering the plastic to the metal. So i'm really curious how Bernstein/Carney and Riddell have dealt with this issue.

On a related issue, i have been building small, weird automatic percussion instruments, both hand-cranked hurdy-gurdy style and powered by various sorts of motors. I've also been mutilating old phonograph turntables by changing their source of motive power. On the drawing board is an auto-robot tone arm which will be able to plop itself anywhere on a record under the command of the er, musician or by a computer. I have to work out a few more of the details, as well as wait patiently for the arrival of the parts, most importantly, a worm gear and clutch assembly.

All of this work is done using surplus and scavenged motors, hand- built primitive electronics and hand-assembled machinery. Because i do not have access to a full machine shop and because i greatly value the ability to quickly modify the mechanical parameters of a system, i have opted against using single-use custom-machined parts for this work (besides, the cost of having things built by a professional shop is far, far too prohibitive!).

Instead, all the mechanisms are built using Meccano parts. This arrangement has been most satisfactory as i have found a good reliable and reasonably inexpensive source of the more esoteric parts that i use, such as worm gears and universal joints, etc., etc.. Still, I hope to someday come across a big old set cheap at some yard sale or flea market.

As for the matter of spurious acoustic noise in these mechanisms, i have managed to solve this problem quite nicely through the use of careful construction and a few standard techniques. My current percussion auto-robot is completely silent (except of course when it is supposed to be making noise) through the use of brass bushings and aluminum shafting, and using universal joints as shaft couplings (thus solving the inevitable misalignment problems). Oh yeah, a rigid support frame for the bearing parts and careful alignment count for a whole lot too.

On an entirely different tack, i've also been exploring the usefulness of deliberate process noise, as in the case of a turntable powered by a clockwork motor. Next comes steam power ....

Neener neener neener.

Enclosed are copies of a few articles on computer control of player pianos. I have enclosed from the same magazine a copy of an article describing a very primitive sort of computer note generator. [*See notes on these articles below – ed.*]

I'm greatly interested by your review of the Het Apollohuis book, especially because Bastien's Mechanium is mentioned. Meccano a "children's" construction toy? At nearly $4000.00 a pop for the largest set, not necessarily. North American readers, Canadian ones especially, will be interested to know that Het Apollohuis books are distributed by Marginal Distribution, at Unit 103 (Lower Mall) 277 George St. N., Peterborough, Ontario, K9J 3G9.

Colin Hinz

From the editor: The articles referred to in Colin's letter are "The Piano's Reproductive System" by Chris Morgan, "Notes on Interfacing Player Pianos" by Carl Helmers, and "Tune in with Some Chips", by Ted B. Sierad, all in the September 1977 issue of **Byte**. The Morgan article is a description of the inner workings of Duo-Art upright reproducing piano from the 1920s (the term **reproducing piano** designates a player piano of more sophisticated design, capable of pedaling and dynamic variation). Morgan finds that the mechanism of this early instrument can aptly be described using terminology borrowed from computer technology. The Helmers article describes and provides circuit diagrams for a computer-controlled interface with the reproducing piano's pneumatic action. The Sierad article describes a computer controllable, programmable musical tone generator, requiring only fairly simple and inexpensive circuitry.

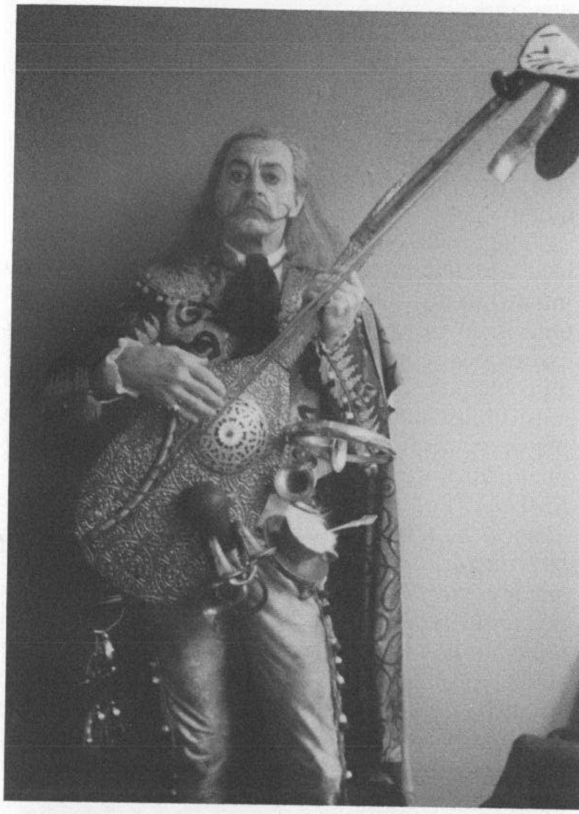
IN REGARDS TO THE PLAYER PIANO STUFF: In Paris there is a wonderful museum in tucked away an alley near the Pompidou Center, the *Musée de la Musique Méchanique*. They have a great collection of organ grinder/hurdy-gurdy things, music boxes, old picture disks, and many roll- and pneumatic-controlled instruments, from the obvious pianos (they have some historic rolls played by famous composers) to violins and banjos, accordions, drums, autoharp, trumpet, and harmonica (!) as well as early electric recording and playback devices (some quite unusual gramophones). In fact, the whole place is really a history of recorded/reproduced sound.

They have weird hours but it is well worth the effort if one is in Paris. The collection is in an old house, and the daughter of the man who started it gives tours every hour or so which include demonstrations of most of the instruments and even some hands-on stuff. They also have a beautiful catalog, with text in French and many photos, available for about $25 or $30 (mine was $20 three years ago, purchased there; I suspect the dolar is worse now, and with shipping I'd suggest at least $30). They are located at Impasse BERTHAUD, Paris 3e. Their catalog also gives and address for the *Groupement des amateurs te musique méchanique*, or GAMM, 42 rue Beaubourg, 75003 Paris. I suspect this is the same people as those who run the museum, as the address is just around the corner.

Steve Peters

I'VE BEEN PERUSING all the material about strings [*in earlier issues of EMI*] with interest. I want to add a little fuel to the fire. In central Java, Indonesia, street musicians sometimes play an instrument that resembles rubber bands stretched around a shoebox. The materials are much stronger. The box is wood about a centimeter thick. Sometimes there is a top but usually the box is a 5-sided, trough resonator affair. The strings are dead bicycle inner tubes twisted tight enough to produce useful tension. I'm not sure if the rubber was cut into strips first, or whether the whole tube was used after the valve was cut out. The strings are knotted so that there are loops at either end. The loops are positioned around fairly heavy nails hammered into the side, or, if the instrument had a top, to pegs which were fashioned by cutting away unwanted portions of the top. All the instruments I saw had four strings. The strings were always plucked with fingers. String tuning was highly variable. Pitches between A2 and A4 or thereabouts seemed to be the loudest. Thus rubber strings other than rubber bands, which I've never liked because they don't last very long under tension, are possible. I'm sure any bike store will be happy to give you all their unpatchable inner tubes if you ask. Yet another lifetime supply of free materials.

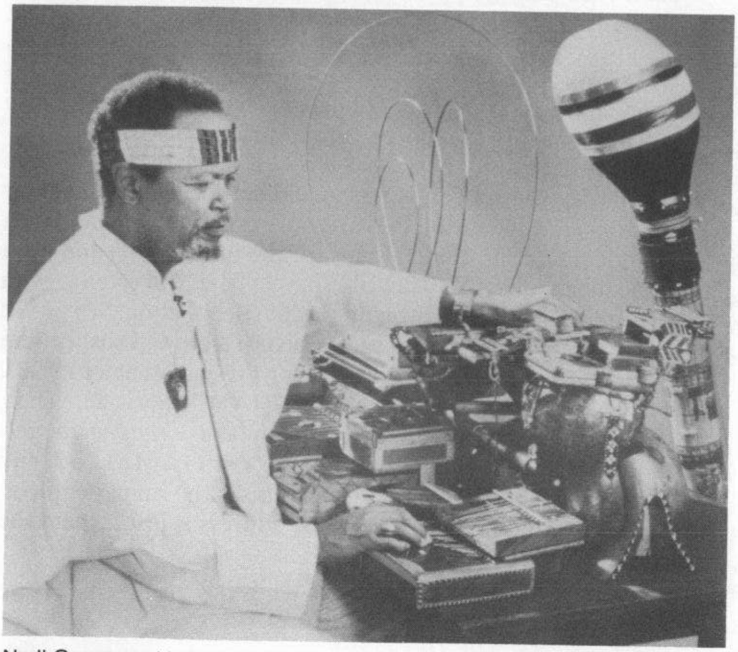
Skip La Plante



Peter Donat as Bazile, in the American Conservatory Theater production of Beaumarchais' **Marriage of Figaro.**

NOTES FROM HERE AND THERE

NADI QAMAR makes kalimba-like instruments in a several sizes and ranges, with some unique additional embellishments. He also makes finger gongs – long, ornately curved metal rods mounted on a wooden base to produce long-sustaining gong-like tones rich in upper partials – and his Taeroviha, a ten string zither into which one sings, adding its resonances to the natural vocal tone. Qamar's recent catalog has descriptions, photocopied photographs and prices for these instruments, as well as information on tapes available. For more information contact Nuru Taa Arts, N3120, Hospital Road, Kewaunee, WI, 54216.



Nadi Qamar and instruments

During this last May and June, THE AMERICAN CONSERVATORY THEATER in San Francisco presented of Pierre-Augustin Caron de Beaumarchais' **The Marriage of Figaro** (1783). A.C.T.'s presentation was not of Mozart's opera based upon Beaumarchais' work, but a new translation and adaptation of the original by Joan Holden, set in Spain in 1930.

In Holden's version the figure of Bazile becomes "an artiste" who can in some ways be associated, in the audience's mind, with the historical figure of Salvador Dali. When the time arrives for music, Bazile (played by Peter Donat) strides forward bearing the glorious instrument shown in the photograph here. Note, in addition to bicycle horns, the tipping teacup at the hip, the eggbeater below, and the Dali-esque melting clock at end of the neck. The instrument served as a stage prop; tragically it is not actually playable.

THE MUSIC ACCESS NATIONAL NETWORKING PROJECT sends this information about their telephone music preview service:

Music Access offers free national exposure of independent artists on its 900 telephone preview service. It's part of an integrated national networking plan to help indie artists and companies get their music out to a wider audience. The Music Access service minimizes the risk of mail order purchase by allowing people to listen to segments of new and hard-to-find music recordings before they put their money in the mail. Music Access does not participate in the sale of the product, but encourages the listener to purchase directly from the artist or company. Callers can

listen to as much or as little as they want and easily access another recording. The service is $.95/minute, a portion of which will fund artist resources and services.

The number is 900/454-3277. Touch tone access codes for hearing specific selections are printed in a monthly newsletter. For more information on using the service or participation for artists & labels, contact Music Access at PO Box 179022, Times Plaza Station, Brooklyn, NY 11217; phone 718/398-2166.

ENVIRONMENTAL MUSIC IN EAR: The May 1991 issue of **Ear** Magazine (published in New York; specializing in new music, broadly construed) focuses on the environment, and features several noteworthy articles on the topic.

Centrally featured are transcriptions of two group discussions conducted with composers active in environmentally-based music. Partaking in the first roundtable are **Ear**'s David Laskin as moderator, and composers David Dunn, Bruce Odland and Helen Thorington. In the second are R.I.P Hayman, Gordon Monohan, and Annea Lockwood. The participants were well chosen: The discussions are full of original thought and insightful ideas, well expressed. The phrase "environmental music" could mean any number of things; but some central concerns emerge in these interviews. Among them are an interest in creating music which is *not* abstracted from its surroundings, but is integral to them, and which can be heard as such; an interest in escaping the effects of degradation of the sound environment resulting from human-made machinery; an interest in shedding inherited notions of musicality and seeking to listen more closely to sound itself; and an interest in creating music which arises directly, even mechanically, out of natural environmental forces rather than depending upon conventional instrumental performance parameters. Implied in all this is the idea that there is something to be gained from greater sensitivity to the environment as it manifests itself in sound, both in terms the aesthetics of listening and humankind's broader relation to the planet.

In the same issue is a piece by Hugh Davies, accompanied by photographs from Travis Ruse and Laure Leber, consisting of a series of "pastoral vignettes." Each vignette is a description of a listening experience/exercise/composition, such as this one: "When a strong wind is blowing, stand at an angle to it with your mouth open; let the wind play different notes as you vary the aperture of your mouth." There is also an article by Niell Strauss on naturally-occurring transmissions in the low end of the radio frequency range, including sferics, whistlers and other signal types of atmospheric origin.

A note recently arrived here at EMI's editorial office from a group called Friends of Ear Magazine, reporting that the magazine, which has always operated at a deficit, is in the midst of a serious financial crisis and has suspended publication until some money can be raised to continue operations. Tax deductible donations can be sent to **Ear** at 131 Varick St. Room 905, New York, NY 10013, USA. Use the same address for subscriptions, back issues or further information.

EMI SUCCUMBS TO POST-DATING CONVENTION

It is normal procedure in the magazine publishing business to set the date appearing on a magazine cover well ahead of the actual date of issue. In fact, the cover date represents the date at which the issue becomes no longer current – an ending date rather than a starting date. The purpose of the practice is to prevent magazines on newsstand display from appearing outdated until the next issue of the same title arrives to take their place. In the past EMI has not followed this practice, but rather taken the hopelessly naive approach of having the issue date correspond to the actual date of issue: subscribers have always gotten their June issue on or about June 1.

Under pressure from magazine retailers and distributors who sell to retailers, we're finally changing this. EMI will continue to appear when it always has – at the start February, April, and so forth through the even numbered months – but the date appearing on the cover will be set one month ahead. Thus this issue, officially released on August 1, is EMI's first-ever September issue. It will be followed in October with a November issue, and so forth through the odd numbered months.

EARTHSOUNDS

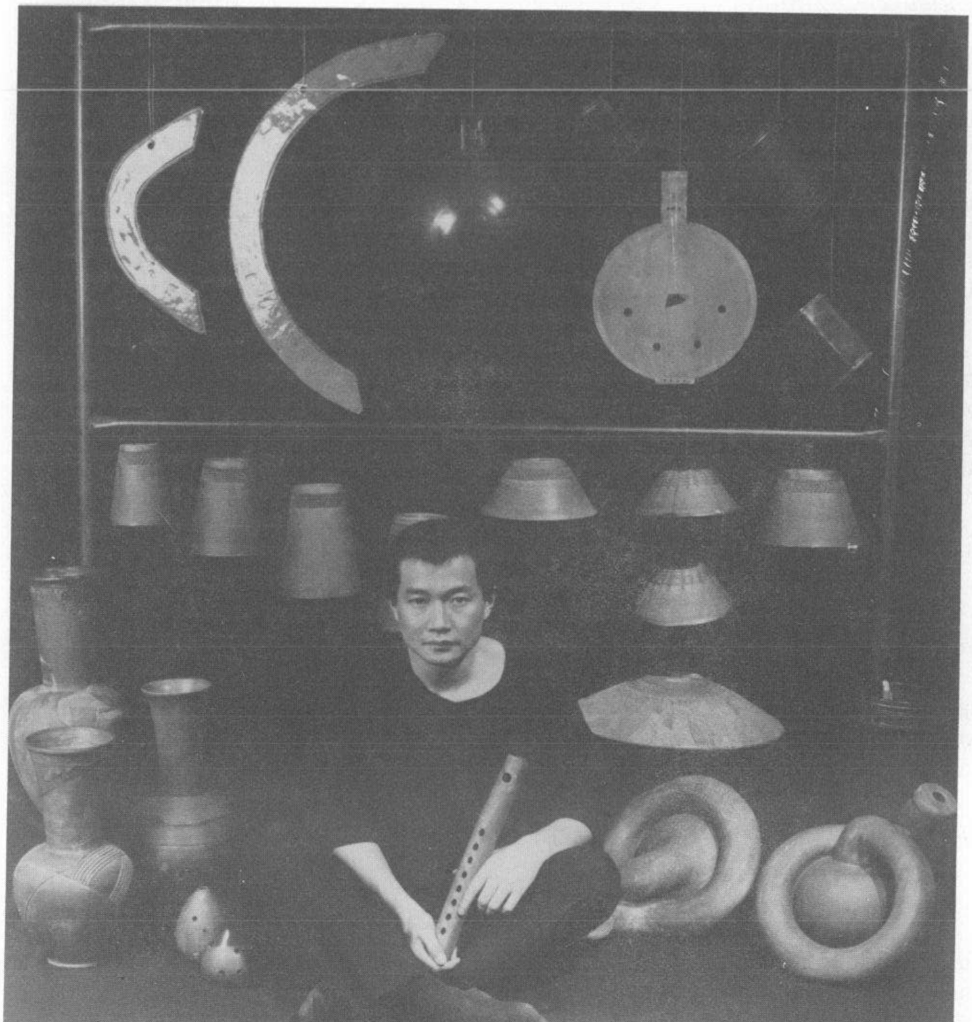
by Ragnar Naess

INTRODUCTION

During autumn 1988, celebrated Chinese composer Tan Dun came to my workshop in Brooklyn with Mary Scherbatskoy, the producer of his opera *Nine Songs*. They were looking for ways to introduce the sound of the earth into the evolving score of his experimental opera. Tan is inspired by the unrefined sounds of traditional ritual music and draws on both Asian and Western technique. He was searching for "sounds from our simplest origins," pure rough sounds of the earth. From this meeting evolved my role as the potter for an opera and co-creator of a new system of musical instruments we call **EarthSounds**. For the *Nine Songs* opera we developed sound forms to be played mainly by striking (gongs, bells and jars) which were used together with traditional Chinese and Western instruments. Seven months later in January 1990 *Soundshape for Ceramics, Voice and Instruments* was premiered at the Guggenheim Museum as part of the *Works and Process* Series. This first composition for the entire **EarthSounds** system made the Earth element central to the evening's music with more than 70 clay sound forms struck, plucked, bowed and blown. **EarthSounds** is the name of our ongoing collaboration as we continue to explore and design clay sound forms.

BACKGROUND

Traditional Chinese music classifies musical sound groups according to the material of which the instruments are made: bamboo, metal, silk, skin and earth. In the Taoist ideal, earth is primary among the elements, and in Tan's composition the sounds of the earth are often enhanced and set off by more traditional western and Chinese percussion instruments. A *New York Times* reviewer said *Soundshape* evoked the feeling of a mysterious ceremonial rite. "He (Tan) seems to be seeking an otherworldly style that is not rooted in any specific musical tradition. He is attracted to primeval timbres: the sounds of the wind, of wooden flutes and whining stringed instruments, of a straightforwardly aggressive thwacking of pottery drums." Note that the flutes and stringed instruments were also all clay!



PROCESS

I am a potter working with stoneware which fires to a very vitreous state at cone 6. This is around 2150 degrees Fahrenheit, which is a medium high fire stoneware. By comparison, flower pots are terra-cotta or low fire and porcelain is high fire. For many years I'd noted the beautiful sounds my functional pottery made when struck and Scherbatskoy knew of this as well when Tan, striking pots in a friend's kitchen, discovered that the sound of this "earth" element was an important dimension for the piece he was writing. Here began a collaboration between the three of us in which we have tried to discover and pursue those sounds peculiar to fired clay. Our roles defining and solving technical and esthetic problems are blurred and we all contribute to the outcomes in the clay system Tan now uses in his compositions. He composes exploring and exploiting the sound potential of the completed clay objects.

Composer Tan Dun with ceramic instruments created in collaboration with potter Ragnar Naess

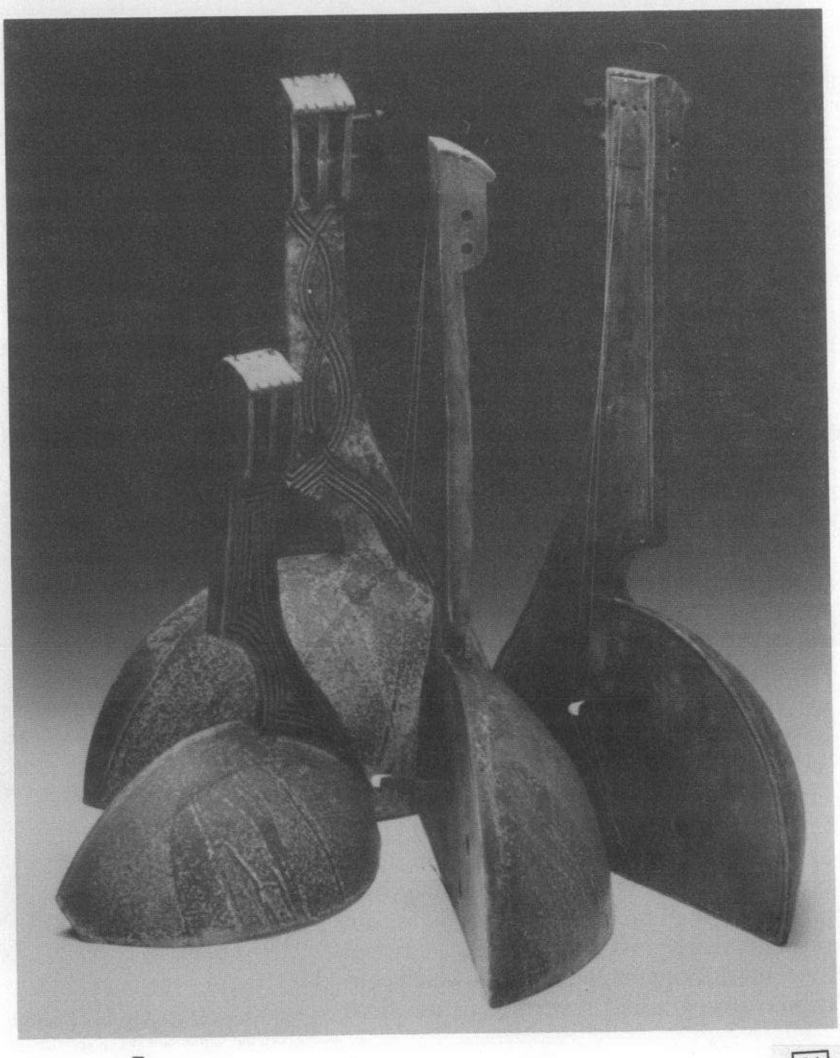
Photo: Beatriz Schiller, 1989

SOUNDSHAPE for ceramics, voice and movement, composed and led by Tan Dun. Guggenheim Museum, New York, January 21 & 22, 1990. Commissioned by Mary Sharp Cronson for Works in Process.
Photo: Ragnar Naess

My role on the team is visual designer, clay technician, conceptualizing in detail actual objects based on what we have visualized and imagined together. I then use my 20+ years of experience making teapots, casseroles and other functional objects to construct, glaze and fire them. I assemble both thrown and slab components in the more complex instruments which are really sculptures. Simpler instruments make use of either a single thrown form or slabs of various shapes. Scherbatskoy has become principal instrument mechanic, carrying out and often inventing systems for installation and staging, solving problems such as how to transport fragile objects to and from rehearsals and performances. As the producer of the performances, she completes the journey from workbench to the world for both Tan and me, raising money, managing public relations and all the complex aspects of theater presentation. Tan gives us incentive and inspiration with his extraordinary aural and visual imagination, without which I would never have been willing to invest the time and effort necessary to explore this potential of my clay. Wind chimes are the only widely used form of clay for sound in the craft marketplace and they never interested me!

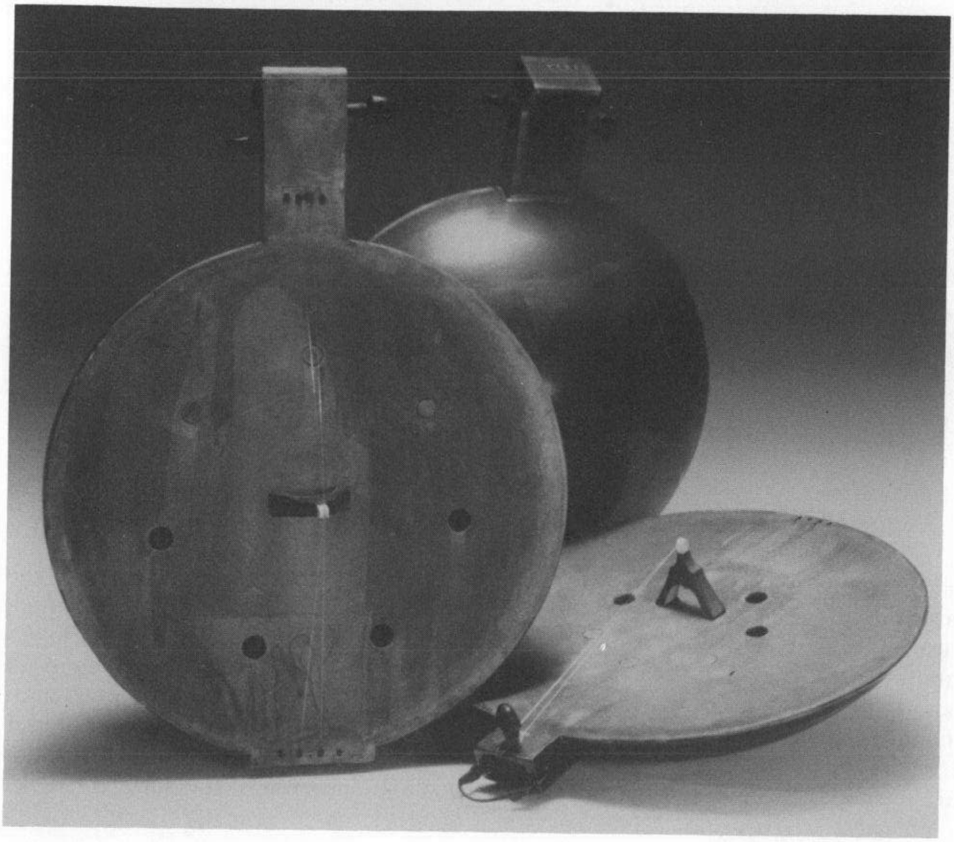
Technical sophistication and complexity has not been our path. None of us is schooled in fancy physics or techniques of instrument making. We started with sounds we found while we walked around the workshop striking, blowing and scratching clay objects, after which I made forms which seemed to lead to good sound. Some instruments also come into being when the need for a particular register, tone, texture or volume sets an objective that leads us to solutions we wouldn't otherwise devise.

We address a variety of questions as we pursue **EarthSounds.** What is unique to the sound of clay? How can we get sound from clay? What is the simplest device? How resonant can this particular clay be and how can we get more resonance? Is the clay's resonance itself what we are seeking in a given sound, or is it the sound of compressed air resonating when trapped in a clay vessel being struck? What can we do with sounds of other materials amplified by the clay reservoir or a clay sounding board? Do some forms amplify their resonance better than others? What effect has form on sound of struck objects? What should be the shape and area of the surface struck?



EarthSound **Bowers**, made by Ragnar Naess in EarthSound Collaboration.

Photo: Ragnar Naess



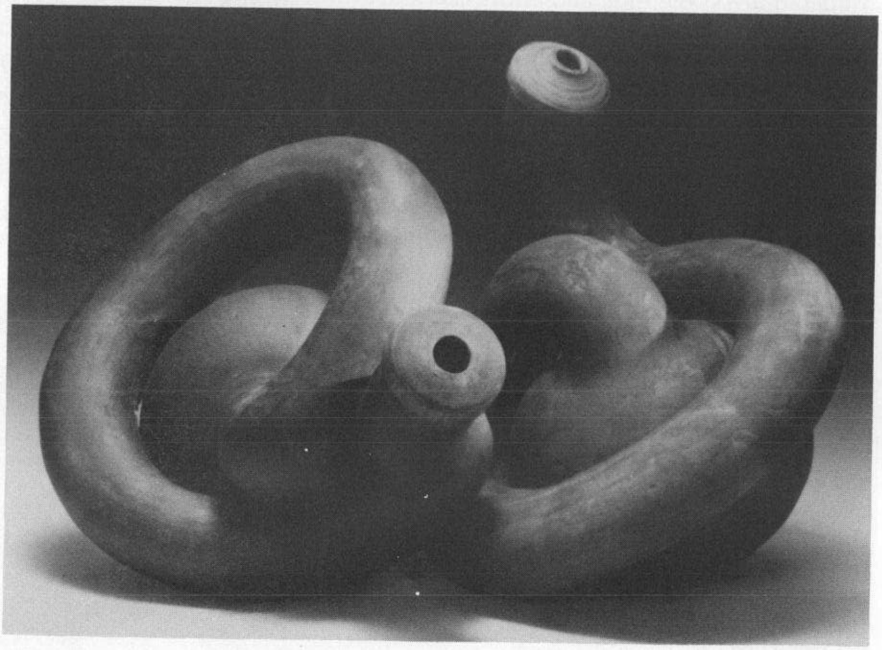
EarthSound **Pluckers**. Made by Ragnar Naess in EarthSound Collaboration.

How thick should walls be? What do hollow bodies with tubular necks give us? How can we make a long tube that will be blown and give a dark, deep sound but survive rehearsals and performances without being broken? Can we put a fragile hollow clay body on a long solid clay neck and put it under the tension of strings as in more traditional stringed instruments? What effect has glaze on the sound of clay objects? What will clay sound like when used to amplify the sound of metal, wood, gut, plastic strings? What is its sound when struck by objects made of these materials?

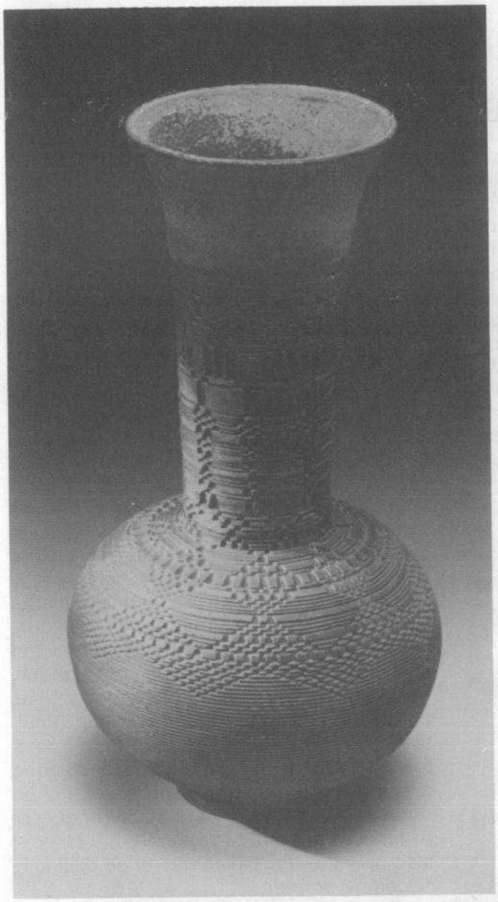
I limited myself to the use of my one studio clay formula. It is a stoneware clay, but I draw from it a sound closer to the brighter tone of porcelain. This sound character, which we pursue in **EarthSounds**, is enhanced by the tight, dense, highly fused fired state of my clay. I believe sound characteristics are influenced by the homogeneity of the melt of the ingredients of the clay, or what we call clay's maturity. Maturity is a measure of tightness and shrinkage achieved in firing. A mature fired clay will not shrink much further if heated to higher temperatures in the firing; ingredients that will melt and combine have done so and anything to be burned away is gone. The unmelted ingredients, aluminum silicate particles, are suspended in a glass "glue" within a lattice of long interlocking mullite crystals which contribute strength and resilience to the fired object. Before it is fired, my clay grog is finely divided, unlike the fairly large chunks of grog often used in stoneware clays. My clay also has rather a lot of iron oxide and calcium in it which act as fluxes, further improving the melt. If this clay formula had larger chunks of refractory ingredients, they would create discontinuities of harder, separate mineral areas within the crystal lattice which I believe would blur the vibrations which determine the sounds clay objects make. (Refractoriness is a measure of how hot something can get before it melts, and a flux is defined as a chemical which lowers the melting point of a mineral.)

We noted that sound is affected much as is light by the type of finish on the clay. Matte glazes which gain their soft appearance by absorbing light in multitudes of tiny holes in the surface also soften and dull sound just the way they soften reflected light. Glossy glazes which are quite fused and not thick created the best sounds.

Thin clay walls under the bridges of the stringed instruments and in the resonating jars enhanced sound quality and volume. Struck objects from which we wanted resonance amplified by trapped air were better struck on relatively small surface area rather than broad flat surfaces. Sounds produced by resonating and vibrating from within rather than from sharp abrupt smacking impacts on the surface were enhanced this way. We also used soft foam rubber paddles to mitigate the impact of striker on ceramic in these resonating jars. The jars are played open, using no skin



EarthSound **Cowguts**. Made by Ragnar Naess in EarthSound Collaboration.
Photo by Ragnar Naess



EarthSound **Resonating Jar**. Made by Ragnar Naess in EarthSound Collaboratiohn.

Photo By Ragnar Naess

or membrane as would be used in regular drums. In search of a good resonating air chamber/neck/striking surface combination, I made a number of vases of various proportions, both in form and relation of body to neck. In the end, we returned to a vase form I'd made as a production piece for some time – a long trumpet neck on a spherical reservoir. It appears, by what I have heard from an ethnomusicologist, that this is a traditional jug drum form worldwide. (For interesting info on clay drums, see EMI Vol. V #5, Feb. 1990, Frank Giorgini on UDU Drums.)

In his scoring, Tan had all the instruments struck on the surface with different materials to get another collection of sounds – wood, metal, plastic, felt and fiber against clay. A set of giant crescent-shaped gongs which we call moons evolved when we started out inspired by the famous Chinese Jade Bells. We found that our large crescent form sounded entirely different when struck on edge rather than on their broad flat surfaces. They gave different sounds struck with wood or little brass cymbals. We also added variety in sounds by varying the thickness of the clay slabs used in making the struck objects. Many other wheel-thrown shapes of bells and gongs are used in multiples organized in gamelan-like systems. Large thin bowls are struck while sitting on traditional timpani to create another sound quality. Distribution of the clay throughout the thrown forms of the bells or bowls alters the pitch: virtually identical dimension and weight objects can have a pitch a note or two apart, and the only variable seems to be the thickness of the clay at different points in the piece. Grove's Dictionary has a long and fascinating technical piece on the physics and manufacture of bells and their sounds – intimidating to me!

For stringed instruments, we pirated tuning keys, bridges and strings from more traditional stringed instruments, but the bodies and necks of all the string instruments are clay. It seems to tolerate well the tension of the tuning, even though the sounding "board" is very thin. One of the stringed instruments – we call it our bower – was inspired by the Chinese violin-like *er hu* with a crook in its neck. Another bowed form has no strings at all, but uses the resonance of clay cylinders stroked on their edges with large cello bows.

Where blowing was used to make sounds as in traditional metal instruments, various horn forms, tubes and reservoirs amplified sound. We solved our quest for deep wind notes by twisting a long clay tube around a bell-shaped end, following the lead of traditional metal wind instruments and creating what we call cow guts. More closing or opening of their volumes gave us varied sound character. (See EMI Vol.V #6, April 1990 on Kelp horns, p. 7, where Bart Hopkin talks about tone color changing with opening and closing of volumes.) We made interchangeable mouthpieces for this horn which we call cow guts so players could alter their use of lips and breath. Working the clay in leather hard state, I could often experiment and check the sound character of struck or blown forms. One wind instrument we use is purely traditional Chinese – the *Xun* (pronounced Shun), a pear-shaped object with nine finger holes, blown across its open top like a bottle. We also use a number of bowl and bottle forms and traditional transverse flutes, but none is tuned for specific notes or scales.

The sound forms we make are not intended as solo musical instruments. Each object works as part of a larger system of sound-making objects and their use in performance feeds back into the process in the pottery shop where they are made.

For further information contact Mary Scherbatskoy, 134 Henry Street, New York NY 10002

Naess has made his living as a production potter, working in the New York City market where he knows personally many of the people who use his pots. They come to his studio in Brooklyn bringing exciting commissions such as the instrument project. He played piano and flute until potting took over his life. Meeting potters John and Esther Sills while earning his A.B. in History at Stanford University started him in his pottery career, and they directed him to study with reknowned Bauhaus potter Marguerite Wildenhain. His work is in the Smithsonian Institution, the Newark Museum and the Taipei Fine Arts Museum, and he has shown work in galleries nationwide.

Scherbatskoy has spent nearly 20 years as co-director of ARTS, Inc., the Lower East Side (New York City) resource center in Chinese and Hispanic Culture. She has a diverse background in the visual and performing arts, Asian studies and building renovation, all of which have contributed to her work on **EarthSounds**.

Tan has achieved an international reputation as a composer for orchestra, new and traditional ensembles and collaborative media. Pieces he composed in China in the early 1980s are now considered among the seminal works of Chinese modernism. He integrates parts of the ceramic system into his writing for conventional orchestra as well as in his commission for the BBC Scottish Symphony Orchestra premiered in August 1990 at the Edinburgh Festival. Future performances of **EarthSounds** include New York, Vermont, Hong Kong, France and the United Kingdom (including the 1991 Edinburgh Festival). **Nine Songs** has been released on CD and cassette by Composers Recordings Inc. (CRI) and can be purchased through CRI, 73 Spring St., Rm 506, New York NY 10012; 212/941-9673.

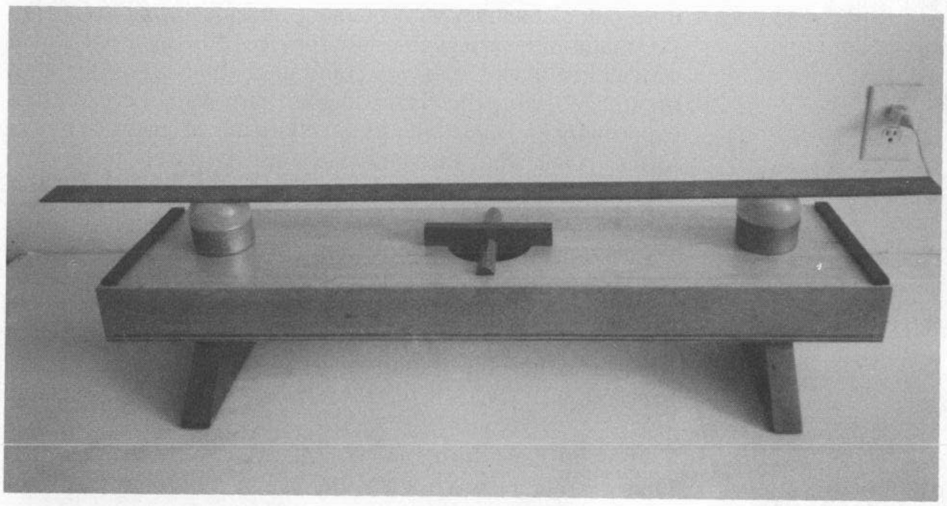
CANS AND SPRINGS AND BARS AND PLATES AND WHEELS

Notes & Photographs by Peter Whitehead

Peter Whitehead has an unusual knack for creating sound instruments of the most diverse and delicious timbres using unassuming materials and relatively simple construction methods. On these pages he provides photographs and descriptive notes for five on his recent constructions.

THE SINGLE BAR (upper photo)

Experiments using balloons, sound boxes and metal bars lead me to the Single Bar. This is a somewhat minimal instrument consisting of a single bar of mild steel resting on two inflated balloons. The balloons sit inside two metal cylinders, which are placed at the nodes for the bar's fundamental vibrating mode, and attached to a wooden sound box. The box is elevated at both ends on legs. A wooden cross placed over the sound hole acts like ribbing in guitar sound boards, and greatly increases the power of the lower frequencies. As far as the physics goes – placing the balloons at the nodes of the bar allows for the fullest vibration of the fundamental mode, while the lightness and compliance of the balloon still allow the higher modes to sound freely. Some sound energy is radiated directly from the bar and off of the surface of the balloons, and some is transferred through the balloons to be radiated by the metal cylinder and the sound box. The balloons allow the bar to almost rest on air, letting it vibrate to the maximum extent. I have noticed that as the balloons deflate over time, that the richness of sound quality increases, producing a wider range of overtones with greater volume.



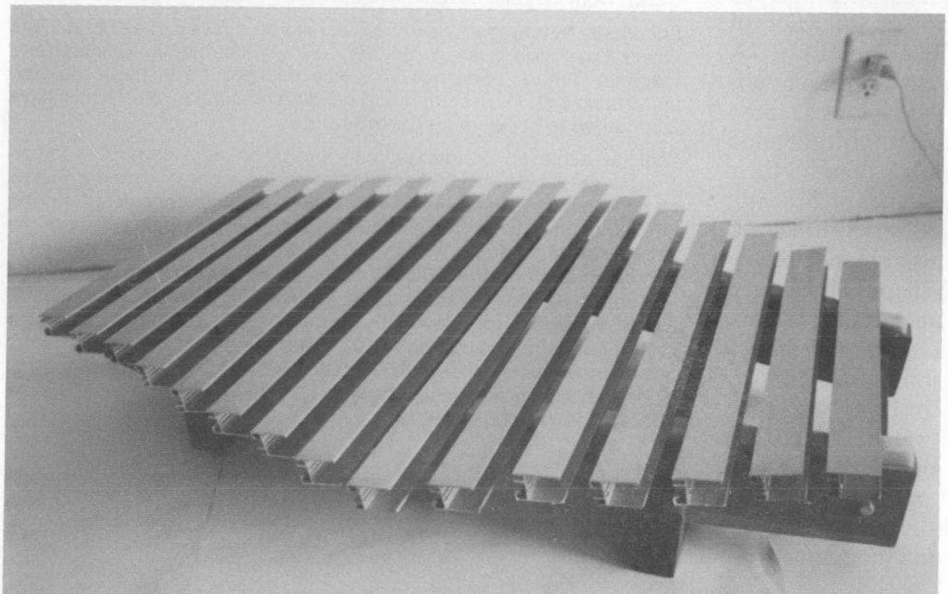
Because of the simplicity of the instrument, much depends on playing technique, i.e. the type of mallet and the method of striking. I have used a wide variety of metal, wood, rubber and plastic mallets as well as bows, often using two types of mallet simultaneously. The sounds contains many overtones with long sustain. A variety of gong and bell sounds, high and low pitched drones and various tinkles can be produced. At times damping can be very effective. I also play the box which has three distinctly "wooden" sounds.

The bars of course are changeable, and I have at present six different ones, each with its own qualities. Steel rods work well also.

THE CHANNEL BARS (photo below)

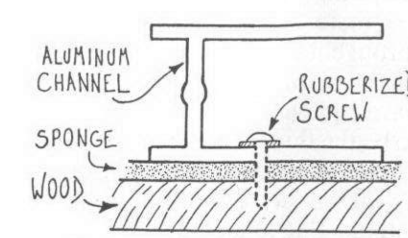
The Channel Bars are a basic xylophone which uses aluminum channel salvaged from sliding glass doors. The bars are arranged in a diamond configuration with all the natural notes (C scale, white piano notes) ascending from the center to the left, and all the accidentals (black piano notes) ascending center to right.

The shape of the channel is of particular note. It consists of two parallel bars of about 3mm thickness, joined along their length by a perpendicular third bar. The channel rests on the lower bar and the parallel upper bar is then supported only by the narrow edge of the adjoining cross-bar. The result is that the upper bar (which is struck) has a lot of freedom to vibrate. This factor coupled with the rigidity of aluminum results in a haunting chime sound with many overtones and very long sustain. A single sharp strike with a rubber mallet yields a sound which hovers quite clearly in the air for fifteen or twenty seconds. This may be used to advantage, or occasionally damped – a tricky technique perfected by Indonesian musicians. Touching the bar at specific points varies harmonics.



There are several options for playing approach, e.g. left to right or right to left – the two scales always ascending in opposite directions – or a mixture of both; or alternatively you may abandon any plan and play intuitively.

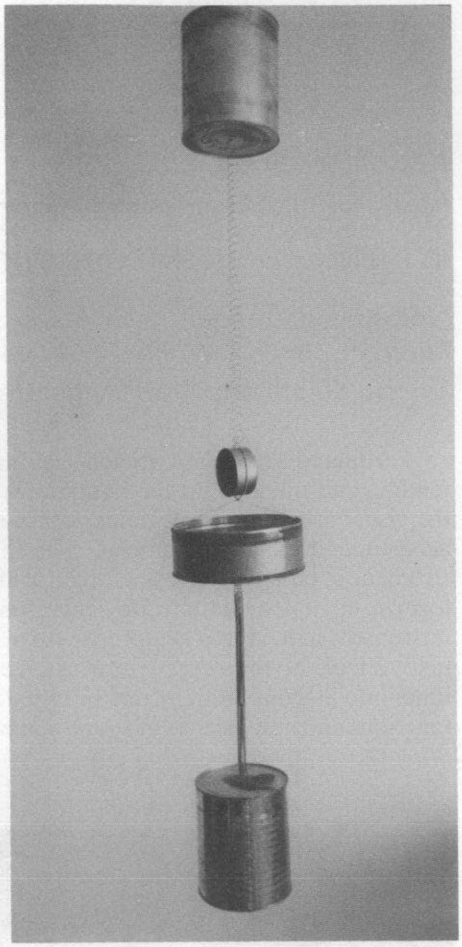
The original model employed no tuning, but the many overtones and long sustain combined to give an undesired effect – which of course may be worth pursuing at a later date.



Aluminum channel bar in crosss section

CAN-CAN (photo at right)

Still in the experimental stages, this instrument is evolving from investigations with springs and metal cans. It consists of two metal paint cans, a cake tin and a small metal can connected by springs and string. Playing the three larger cans produces a metal drum sound with strong reverb and long delay time. Different parts of the surface have correspondingly different sounds. The small can rings. The springs can also be played, either with mallets, by hand, or with a bow. Their sound is amplified by the cans at both ends. Since all cans are connected, their sounds are inter-related. The arrangement is in some ways reminiscent of sounding devices discussed in EMI's recent articles on conjoined string systems [EMI Volume VI #6 and Volume VII #1], particularly Paul Panhuysen and Johan Goedhart's long string installation **Chance**.



SPOKE-SPEAK

(photo at left)

Spoke-Speak is constructed from a metal garbage can, a bicycle wheel with re-arranged and tuned spokes, metal rods, a steel bowl, a pan lid, a diamond saw blade and a spring. A perforated transverse bar supports various elements and provides hanging places for any number of attachments to strike the spokes when the wheel turns. All parts of the instrument can be played, and the sound is amplified by the metal base surface. Water can be added to the bowl. As with many instruments (if not all) what you play it with is as important as the instrument itself.

THE METAL CONE (photo at right)

The Metal Cone is a simple cone of (so far) five steel circular plates, joined through their centers by a metal rod and supported on a stand. The plates act as crude cymbals, but are flexible enough to allow a wide range of sounds depending on playing technique. Long rolls and dragging of mallets over the surface while bending produce dramatic sounds. Metal mallets give very high frequencies; softer mallets produce rumbling. Other sounds range from jungle animal calls to delicate metallic reverb and light rain. Brushes are very effective also. Each layer has its distinct set of sounds. A further project is to build a complete cone with no stand and many more plates.

In all of these photos except #3 I used the electrical outlet on the wall as a scale. Many people complain, "what's that doing in the picture?" but it was intentional.

Peter Whitehead can be reached by telephone at 415/621-8906.

FERDINAND FÖRSCH: SOUND IMAGES and other sound works in metal, wood, skin and string

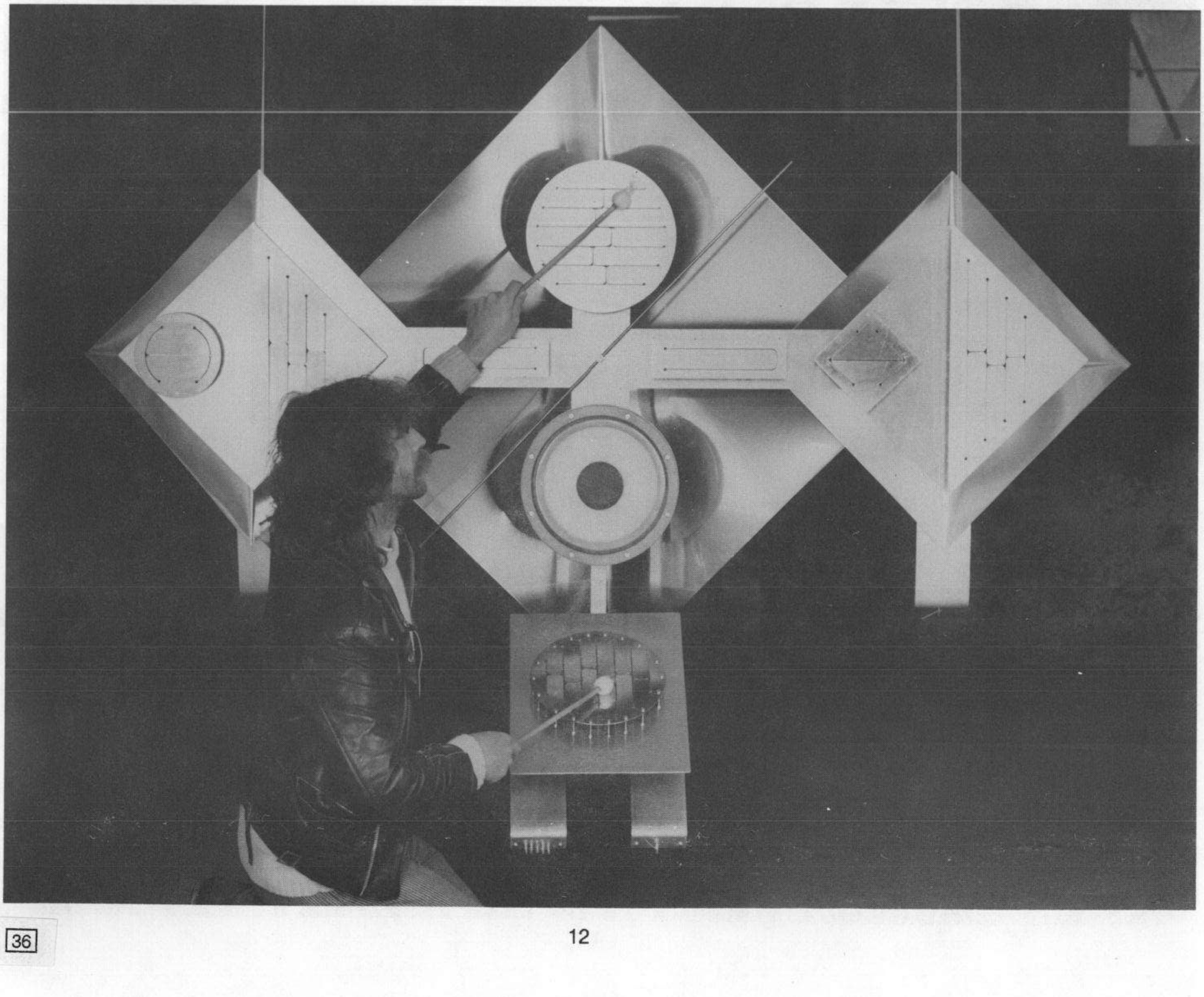
Notes by Iris Tenge
Photographs by Wolfgang Klein, Denis Brudna, Christa Kujath and Krafft Angerer

Ferdinand Försch's particular aim and interest lie in extending and opening up the boundaries between music and the visual arts. His work is distinguished by an interplay of acoustic and visual phenomena. The shape of a musical instrument is largely determined by its function. And yet the form itself has a definite presence; one can perceive the instrument indeed as a sculpture. It is equally interesting to take a look at the reverse process, i.e. form determining function: Starting from formal or visual considerations, new functions and new aspects of sound can be found. In combining both ways of going about it, a chain reaction of mutual influence is set forth, opening up a whole field of potentially new solutions.

The examination of the complex connections between the visual and the audible turns out to be a trace upon which one discovers familiarity in the seemingly new, and looks at the well-known in a new light. Structure appears, and shows itself as an immanent related-ness.

Both structure and experiment, construction and coincidence (or chance) play an equal part in Ferdinand Försch's working method, aimed at looking for, allowing for, and giving shape to a uniqueness of identity in the object and its sound.

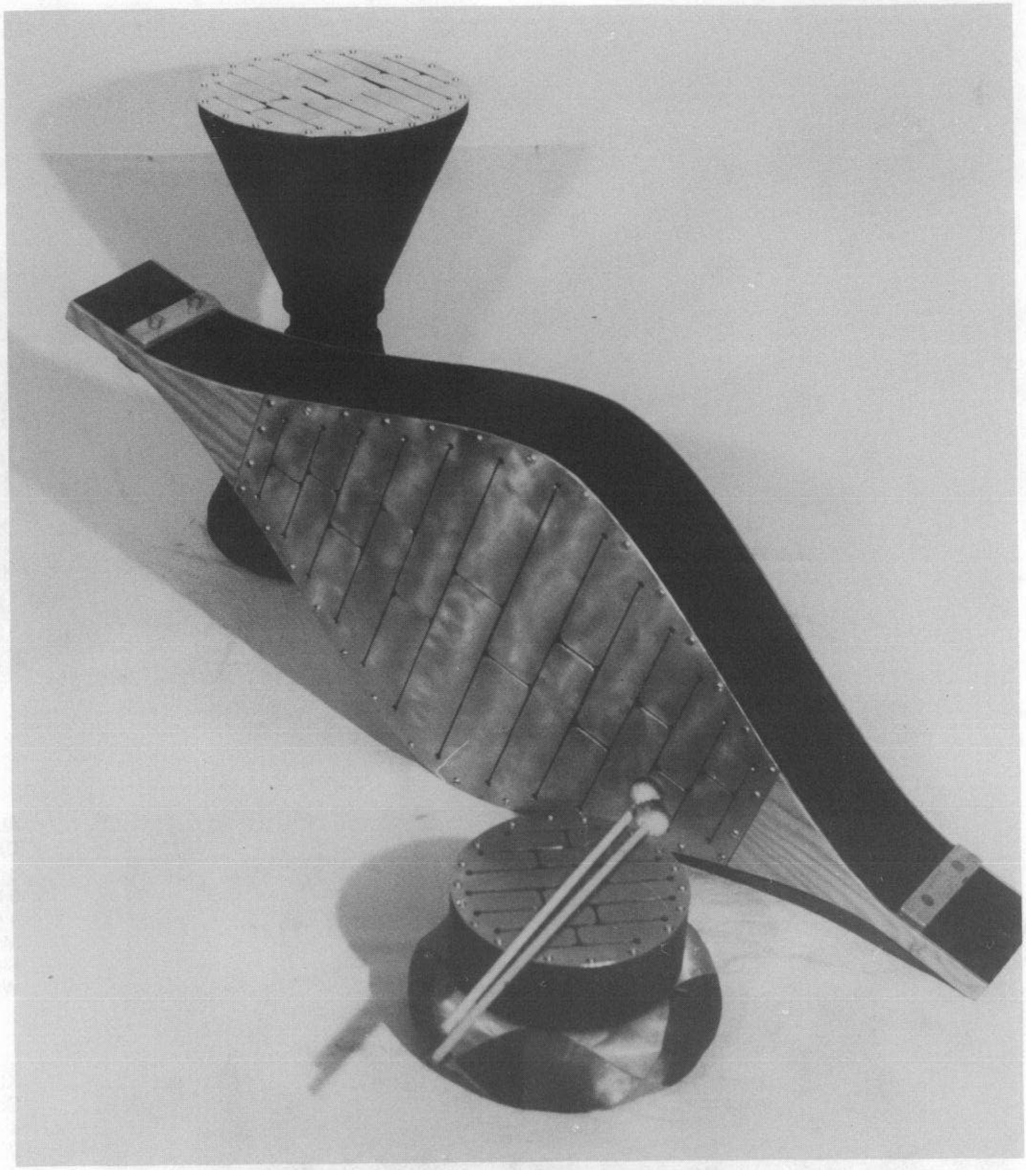
Ferdinand Försch has been working for about ten years on the development of new musical instruments, sound sculptures, mechanical sound installations, etc., and on joining these new means to his original field of percussion and composition. He also continues to perform, occasionally in collaboration with his wife Iris Tenge, a dancer and choreographer. Their home base is near Hamburg, Germany. Contact address: Schloss, 2059 Wotersen, Germany.

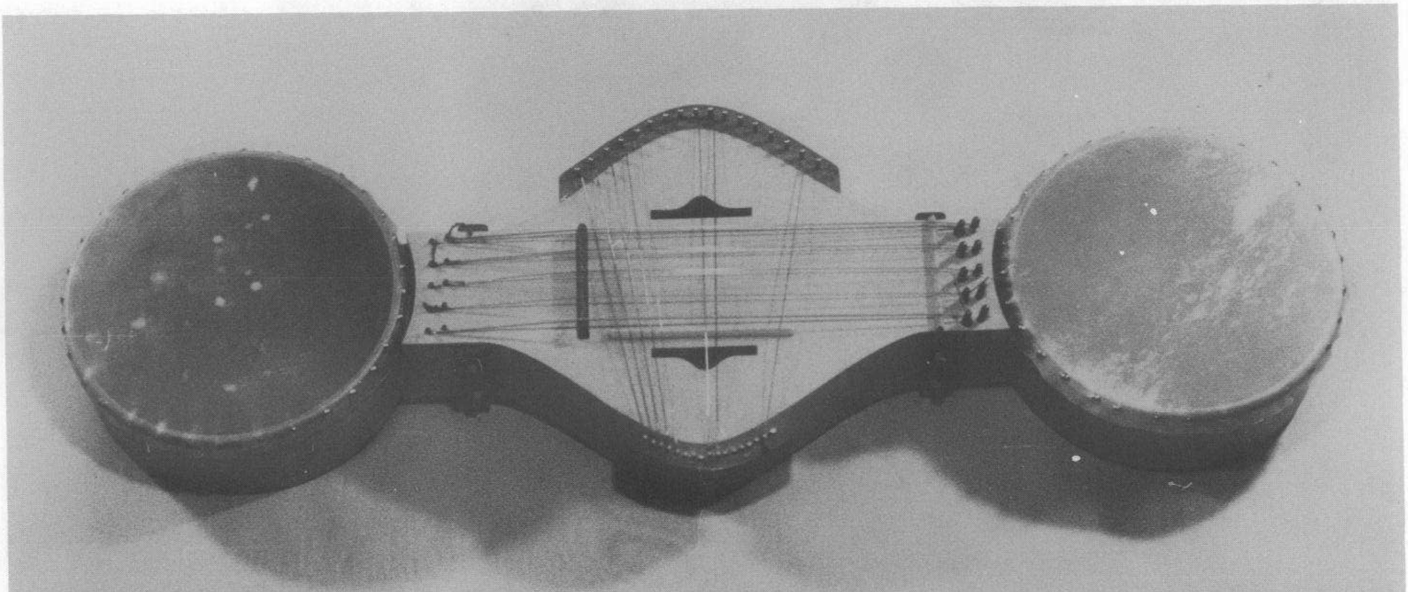


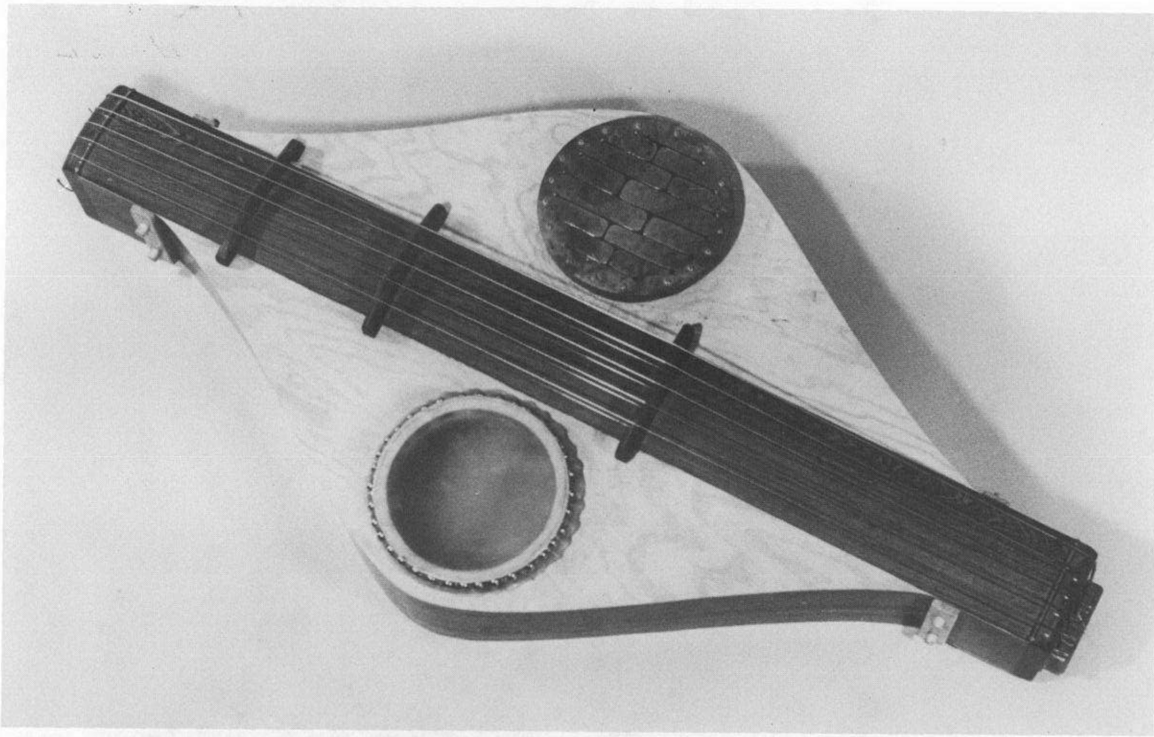
Facing page:
KLANGBILD III
Copper, brass & aluminum
3 steel resonators
5 bows with various strings
Wood-framed skin drum
Brass stick

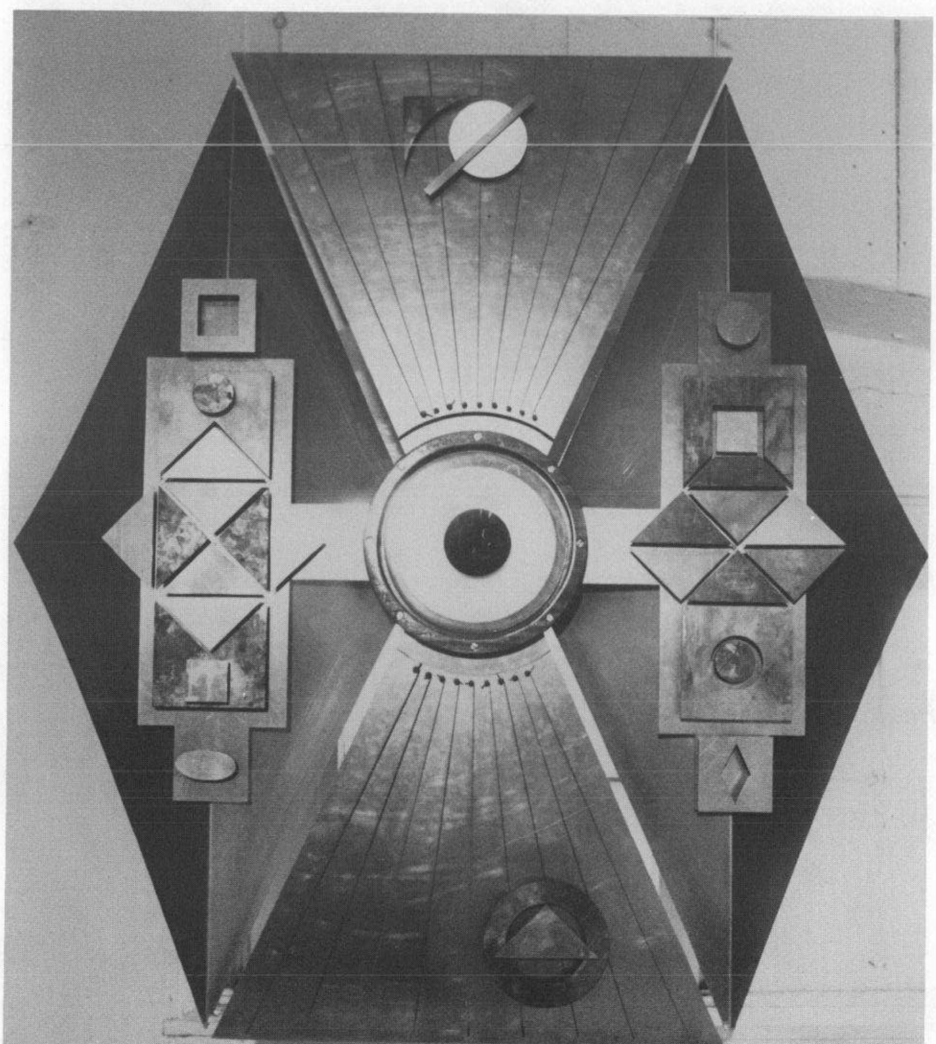
Right:
THREE METAL DRUMS:
Samduhr-Trommel,
Fischaugen-Trommel
and Magic Drum
Wood, brass, aluminum

Below:
DRILLING
5 piano strings,
5 bass strings,
and 17 zither strings
2 bridges,
2 skin drums
Wooden resonator







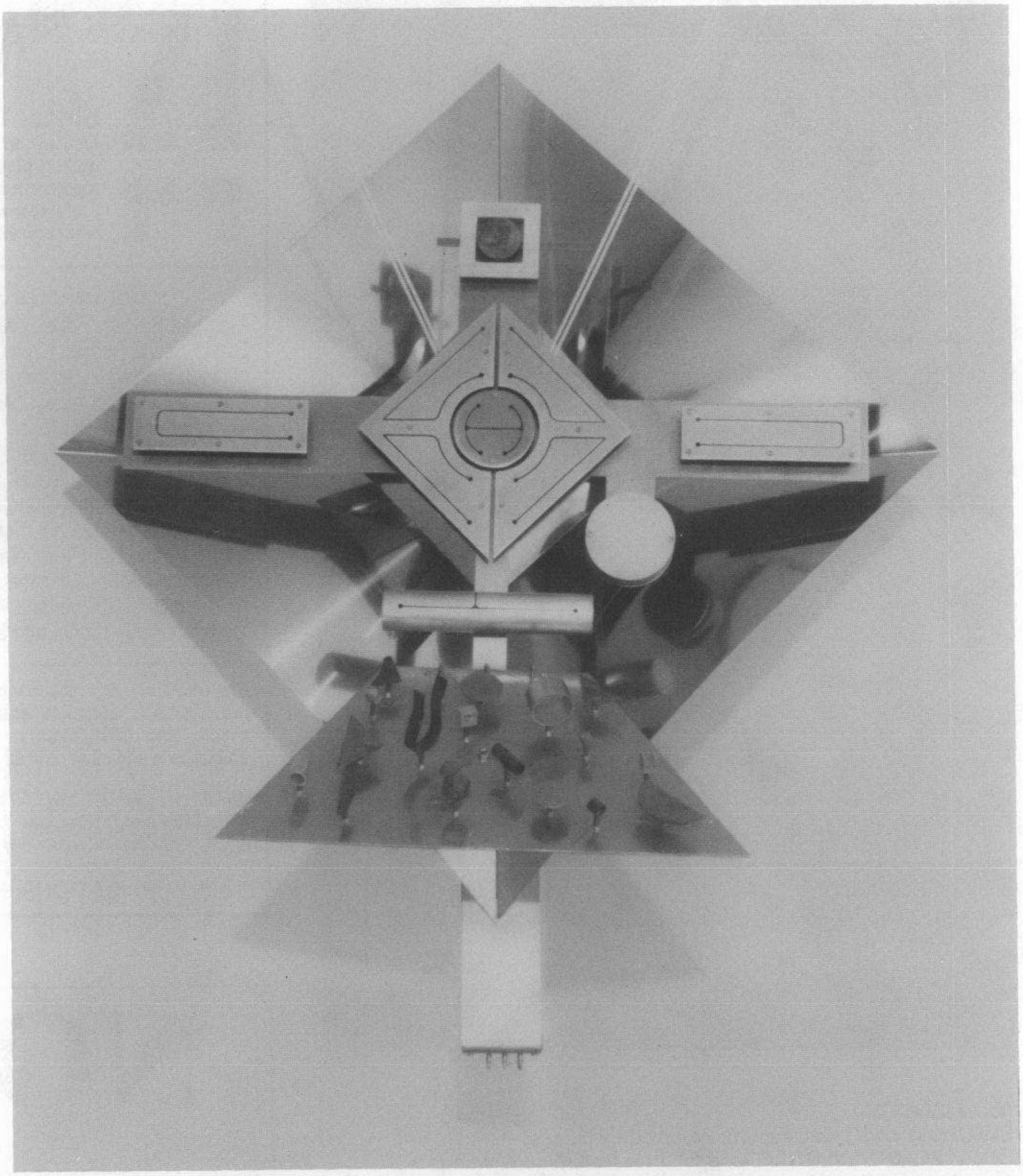


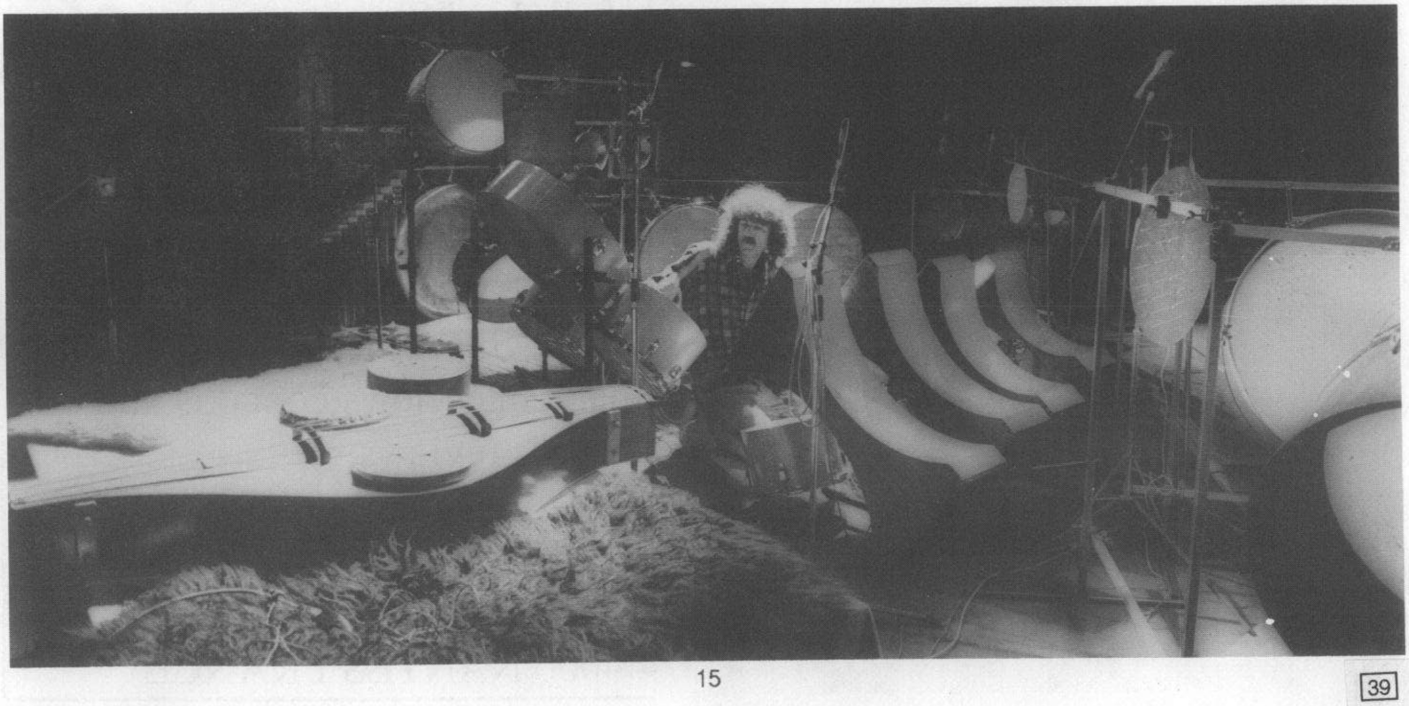
Above:
DRUM-BASS
3 adjustable bridges
5 bass strings,
4 piano strings
Metal drum
Skin drum
Wooden resonator

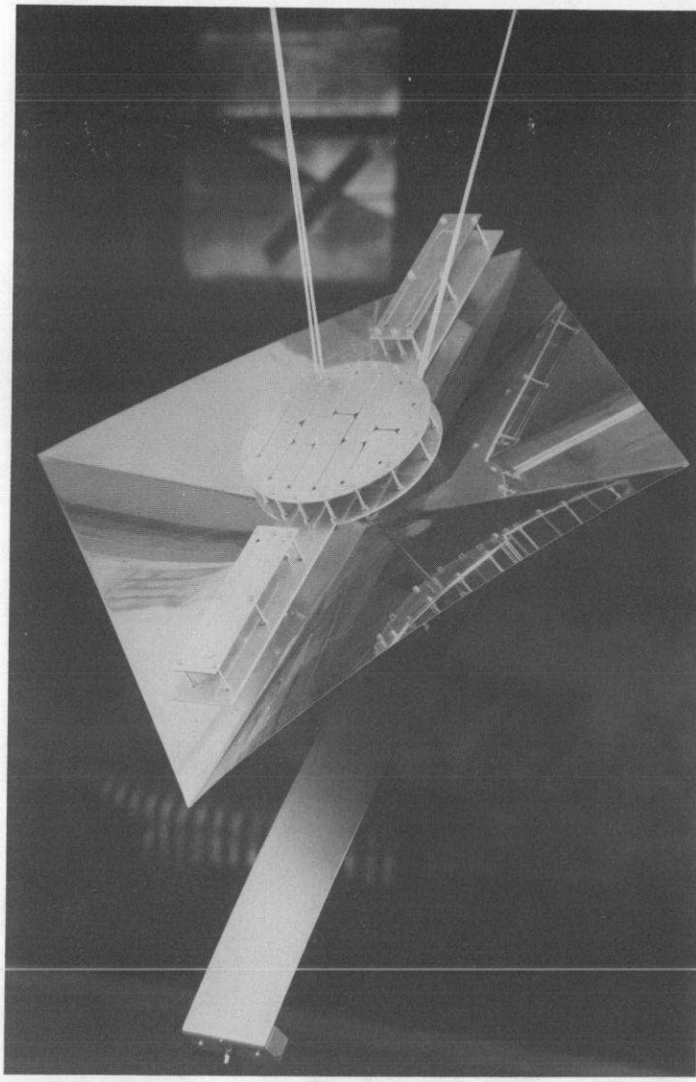
Left:
KLANGBILD VI
Copper, brass, aluminum
4 resonators
Various strings
Wood-framed skin drum
3 bows

Right:
POLYTON II
Copper, brass,
aluminum, wood
1 steel resonator
1 bow with piano strings

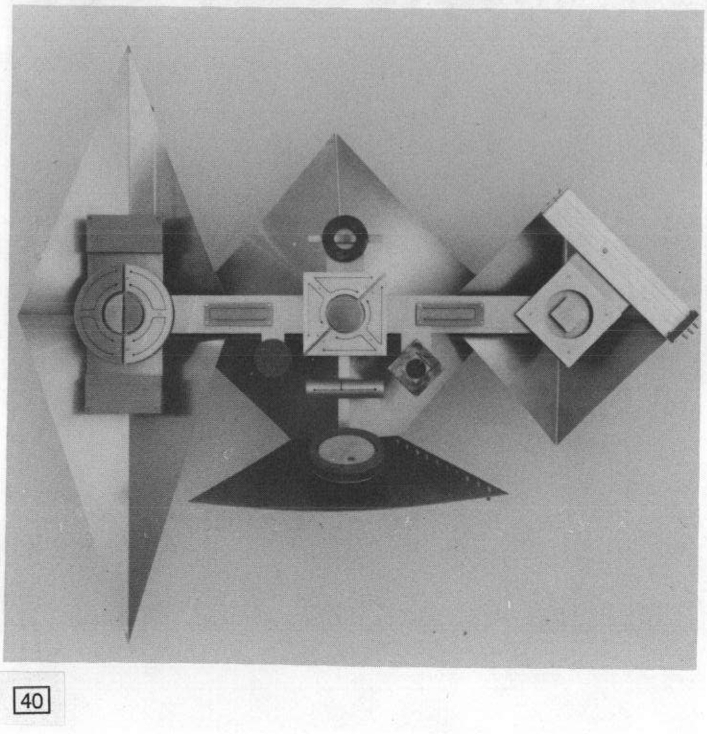
Below:
BALLAD FOR
METAL DRUMS
Concert at Fabrik,
Hamburg, 1984







Above: **ARCTON**.
Steel, brass, copper, aluminum. Metal bow with bass string.
Below: **KLANGBUILD VII**3. Copper, brass, aluminum, wood.
1 steel resonator, 1 bow with piano strings.



FAMOUS EARLY COLOR ORGANS

by Kenneth Peacock

(continued from page 1)

means of expression employed by artists in other fields is much older than one might at first suspect. Music has frequently been associated with the concept of color since before the time of Aristotle, and the ancient philosophers believed that harmony could best be described as the union of varied colored things.

"Color in music" has had many meanings. At different times, the term has described purity of tone, instrumental quality, melodic ornamentation, or even literal color in manuscripts. For example, in the eleventh century red and yellow lines indicated the pitches F and C before the development of musical staves. Comparisons between music and color have seemed a most natural human activity, and the topic has been of interest to writers in many fields.

In 1690, the English philosopher John Locke mentioned that a blind man had claimed the sound of a trumpet was like the color scarlet. This prompted heated international discussions during the eighteenth and nineteenth centuries concerning the possibility of correspondence between light and sound. Understanding the nature of light was perhaps as important to the debate as the development of an art-form which unified different modes of expression.

Both sides of the question were articulated by the poet Goethe, who first embraced but later rejected the idea of an analogy between musical tone and colored light. Such analogies were encouraged by the new theory that both sound and light were the result of similar vibrations of a medium. Air provided a medium for sound, and "luminiferous ether," thought to pervade the universe, was the substance through which light could travel. It was postulated that only the rate of vibration was responsible for the nature of the effects produced in each case. This idea gained support because coincidental mathematical similarities in vibration ratios are seen if one end of the visible spectrum is compared to the other, and in turn compared to vibrational relationships within a musical octave. For example, the vibrational frequency of violet is approximately twice that of red. And some believed that if the sound of middle-C could be raised by forty octaves, one would see red light.

Sir Isaac Newton had been the first to observe a correspondence between the proportionate width of the seven prismatic rays and the string lengths required to produce the musical scale D,E,F,G,A,B,C. Several nineteenth-century scientists cautioned against over-simplifying the analogy, but the belief that light and sound were physically similar persisted in textbooks published after the first third of our century. The existence of luminiferous and electro-magnetic ether was disproven by the Michelson-Morley experiment of 1887; yet over twenty years later, one writer interested in the possiblities of combining color and music attempted to "sum up the scientific side" by stating:

> In a general way it seems to be indicated that harmonic colours are the results of vibratory effects upon the eye of multiples of like measurements, thus fulfilling exactly the analogy according to which harmonious effects are produced upon the ear.

There always has been a considerable lag time before artists have incorporated new scientific findings into their work, but in the case of what was termed "color-music," scientific agreement seemed an unnecessary prerequisite to the development of the new art-form. One consequence of the lively debate over correspondence between colored light and sound was widespread interest in a viable color-transmission instrument which could be operated from a musical keyboard. Early proposals date from shortly after the initiation of the controversy.

THE EIGHTEENTH-CENTURY *CLAVECIN OCULAIRE*

A French Jesuit named Louis-Bertrand Castel (1688-1757) was the first to respond with a proposal for the performance of color-music. Well known during his lifetime, Castel was considered an eminent mathematician, but his writings also show an interest in aesthetics. His work attracted attention in England where he was made a Fellow of the Royal Society--an honor probably bestowed because of his reputation in mathematics, not because of his *clavecin oculaire.*

Castel wrote two major essays concerning a "harpsichord for eyes." The first was in the form of an extended letter (dated 20 February 1725) published in the November 1725 issue of **Mercure de France**. A development of those ideas appeared in **Memoires de Trevoux** (1735) under the title, "Nouvelles experiences d'optique et d'acoustique." It was translated into German and annotated by the composer Georg Philipp Telemann who had it published in quarto. This second essay was also translated into English in 1757 by an anonymous student who had apparently assisted Castel with some of his experiments. The idea for a *clavecin oculaire* was stimulated by writings of Athanasius Kircher (1601-1680), who had experimented with the *magic lantern* – an invention which became the slide projector. In his first article on the subject, Castel asked:

> Why not make ocular as well as auricular harpsichords? It is again to our good friend [Kircher] that I owe the birth of such a delightful idea. Two years ago I was reading his Musurgia: there I found that if during a beautiful concert we could see the air which is agitated by all the various tremors of the voice and instruments, we would be astonished to see it sown with the most vivid colors.

Apparently Castel considered himself a philosopher rather than a technician, and he originally intended only to theorize about the feasibility of making color-instruments, but his ideas encountered skepticism. This prompted him to construct a model which was completed in 1734. It is not clear whether he wanted his *clavecin oculaire* to accompany sound, or to substitute colors for sound according to his particular system of correspondence which was influenced by the discoveries of

Sir Isaac Newton.

Newton had described important prismatic experiments in papers read before the Royal Society, and this information was later published in his **Opticks** (1704). Reflecting a preoccupation with systems of order which characterized philosophical thinking during the Age of Reason, Newton considered the fundamental order of the spectrum i.e., red through violet, to be equivalent to the "natural" order of tones from C to B. Castel, however, believed that the color blue was analogous to C, and he modified Newton's distribution of the visible spectrum. The harpsichord keyboard of Castel's *clavecin oculaire* controlled colors indicated in TABLE I.

TABLE I

Keyboard Colors Proposed by Castel for his **clavecin oculaire** (18th century)

C	Blue	F-sharp	Orange
C-sharp	Celadon (blue-green)	G	Red
D	Green	A-flat	Crimson
E-flat	Olive green	A	Violet
E	Yellow	B-flat	Agate
F	Apricot (yellow-orange)	B	Indigo

Describing how one should play his instrument, Castel wrote:

Do you want blue? Put your finger on the first key to the left. Do you want the same only 1 degree lighter? Touch the 8th note. If you want it 2 degrees, or 3 degrees . . . , touch the 15th, or 22nd, or 29th, or the last to the right. If you want blue-green, touch the first black to the left. Do you want red, and which red? Crimson-red? That is the 4th black. You have only . . . to know your clavier and know that blue is C and red is G etc. This you can acquire with three days practice.

This description clearly implies an instrument of five octaves. In his **Optique des couleurs**, Castel proposed to implement his color system via harpsichords constructed with twelve octaves! He believed the limits of aural perception encompassed twelve octaves (from 16 to over 65,000 cycles per second), and since colors were analogous to sounds, arrangement of color tints should follow a similar pattern. Thus by mixing various amounts of white and black into each of the twelve pigments, 144 different colors would be obtained for the *clavecin oculaire*. Castel had first attempted to use prisms for his instrument, but the colors obtained by refraction of light were probably not of sufficient luminosity. He abandoned this method. Later experiments were conducted with candles, mirrors and colored papers. Each key operated one of the 144 cylindrical candle covers, allowing light to shine through colored paper when the flame was exposed.

Telemann reported that Castel was encouraged by his friends to seek practical realization of his plans, and "without the aid of craftsmen he [had] nearly finished [the project]." This statement was apparently based on Castel's own remarks, but it is misleading because no full-sized *clavecin pour les yeux* was ever built. Albert Wellek concluded over a hundred years later, after investigating all of the documents pertaining to the issue, "Above all there can be no doubt that Castel's construction was certainly begun, but by no means did this lead to a fortunate termination." There also seems to be little evidence that the model of Castel's instrument performed according to his expectations. A copy of the 1757 brochure entitled **Explanation of the Ocular Harpsichord Upon Shew to the Public** (the anonymous translation of Castel's essay of 1735) is located in the British Museum. The envelope which contains the pamphlet has a handwritten note signed by M. Low, the first owner:

. . . I was admitted among a select party to a sight of [this instrument] at the Great Concert Room in Soho Square; but to a sight of the instrument only, for nothing was then performed nor afterwards, as ever I heard, neither did I ever know why.

In spite of this, there is no question that the interesting experiments of Father Castel were directly responsible for development of other theories and instruments in the first half of the nineteenth century. Although these yielded no lasting results, they led to later innovations which initiated our own audio-visual age.

NINETEENTH-CENTURY INSTRUMENTS

Castel had proposed a color-music technology employing diffuse reflection of light from pigment. In 1789, Erasmus Darwin (grandfather of the renowned naturalist) suggested that the newly invented Argand oil lamps might be used to produce visible music by projecting strong light through "coloured glasses." This is probably the basis for the instrument described by D.D. Jameson in his phamphlet, **Colour-Music** (1844).

Jameson specified a system of notation for the new art-form and also described his apparatus in some detail. A darkened room in which the walls were lined with reflecting tin plates provided the setting for his "colourific exhibition." In one wall, twelve round apertures revealed glass containers filled with liquids of various colors corresponding to the chromatic scale – "the bottles seen in the windows of druggists' shops can be used for this purpose." These acted as filters for light projected from behind the wall. Moveable covers were activated by a seven-octave keyboard, and each was raised a specific height depending on which octave was chosen.

Another intriguing instrument was constructed between the years 1869 and 1873 by Frederic Kastner. This was a type of gas organ which the inventor called a *Pyrophone*. EMI readers will recall letters to the editor on Kastner's instrument written by François Baschet, with a technical diagram (Vol. VI #5); Michael Meadows (Vol. III #4); and others (Vol. III #6). His idea was undoubtedly developed after hearing the sound made by gas jets which where commonly used for interior lighting before electricity. Supposedly, the apparatus produced sounds like the human voice, the piano, and the full orchestra. Cylindrical filters covered ignited gas jets (Fig. 1). Kastner later extended possibilities for the visual portion of his experiments after electricity became available. A device he termed the "singing lamp" was essentially,

a sort of pyrophone with thirteen branches, all decorated with foliage and furnished with burners containing several gas jets, which opened into crystal tubes. These burners were brought into play electrically, through an invisible wire that connected to a keyboard in a neighbouring room or street — or indeed another part of the town.

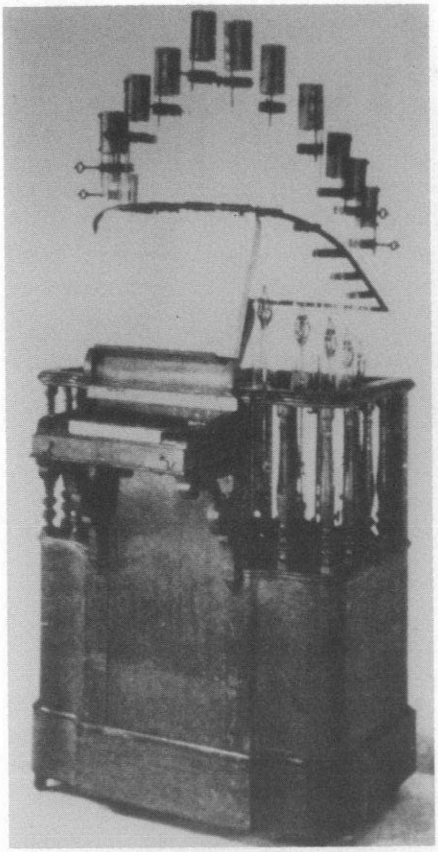
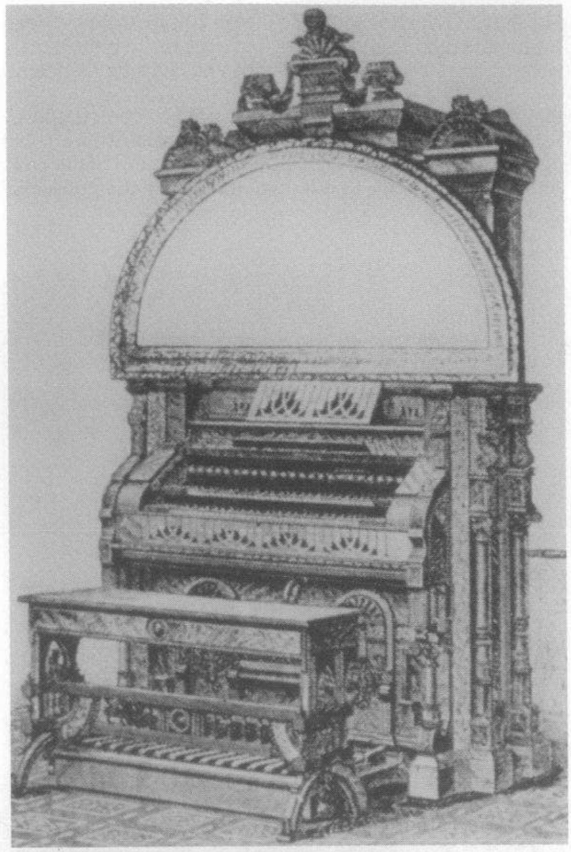


Fig. 1 (LEFT): Frederick Kastner's **Pyrophone** (ca. 1870). Ignited gas jets opening into crystal tubes were controlled from the keyboard. In addition to a visual display, the instrument was reputed to produce sounds like the human voice or a full orchestra.

Fig. 2 (RIGHT): Bainbridge Bishop's device for "painting music" (1877). The light-producing apparatus was placed on top of a normal organ, and a system of levers and shutters allowed colored light to be blended on the screen while music was performed. P.T. Barnum had one of these at home. It could be considered similar to today's "color-organs" which are attached to home stereos.



In 1877 Bainbridge Bishop, who had been interested in the concept of "painting music," constructed a machine in the United States which was to be placed on top of a home organ (Fig. 2). A system of levers and shutters allowed colored light to be blended on a small screen at the same time a piece of music was performed on the organ. Sunlight was first used as the source of illumination, but later an electric arc was placed behind the colored glass. Bishop's invention attracted P.T. Barnum's attention, and he had one of the instruments installed in his Connecticut residence. A bold proposal was advanced by William Schooling in an article published in **The Nineteenth Century** (July 1895). Although there is no evidence that an instrument was actually built, his suggestion to use vacuum tubes of various shapes is remarkable. Contacts on a keyboard would electrically activate individual tubes, and the intensity of illumination could be varied with a pedal to alter current levels. It is not difficult to see this concept as a forerunner of todays computer-controlled artistic or commercial lighting systems. They are so prevalent that we now take these displays completely for granted.

The best-known color instrument of the last century was patented in 1893 by Alexander Wallace Rimington (1854-1918). The inventor, a Professor of Fine Arts at Queen's College in London, called his apparatus the *Colour-Organ* and this name has become the generic term for all such devices designed to project colored light. Rimington described his instrument and the color theories upon which it was based in a book entitled **Colour Music: The Art of Mobile Colour** (1911).

Rimington was convinced that physical analogies of some kind existed between sound and color. In his book he repeatedly compared the two phenomena, claiming both "are due to vibrations which stimulate the optic and aural nerve respectively." Much space was devoted in the appendix for supporting viewpoints. He did admit, however, that the analogy was along broad lines and that the correctness of his own theory was open to question. Rather than attempting to show an exact parallel between vibration frequencies of light and sound, he divided the spectrum into intervals of the same proportions as occur in a musical octave. Thus the ratio between two light waves approximated that for a corresponding interval in sound. Rimington's color scale is shown as TABLE II. Each octave contained the same colors, and registral placement of colors was directly proportional to saturation i.e., higher octaves contained more white light.

TABLE II

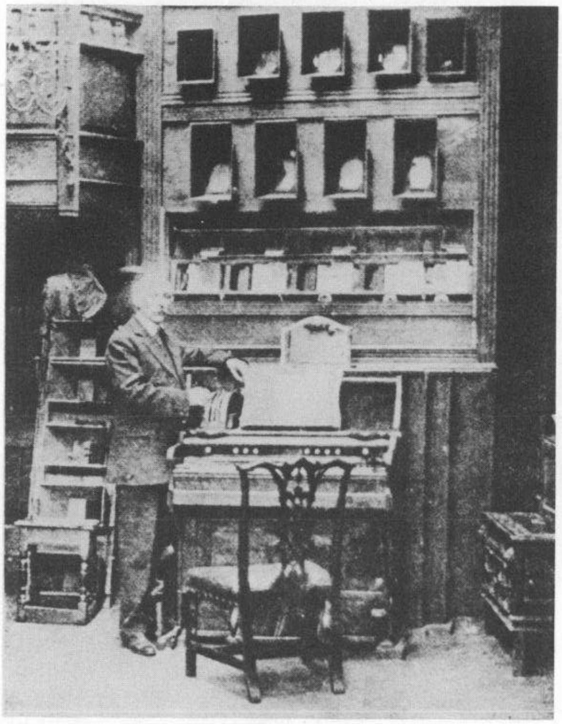
Colors Produced by the Keyboard of Rimington's **Colour-Organ** (1893)

C	Deep red	F-sharp	Green
C-sharp	Crimson	G	Bluish green
D	Orange-crimson	A-flat	Blue-green
E-flat	Orange	A	Indigo
E	Yellow	B-flat	Deep blue
F	Yellow-green	B	Violet

The Colour-Organ stood over ten feet high (Fig. 3). A very complex apparatus, it employed many filters varnished with aniline dye, fourteen arc lamps, and it required a power supply capable of providing 150 Amps. The five-octave keyboard resembled that of an ordinary organ and was connected by a series of

Fig. 3 (BELOW): Alexander Rimington with his **Colour-Organ** (1893). This instrument produced no sound, but trackers from the 5-octave keyboard were connected to lens diaphragms and filters for fourteen arc lamps.

Fig. 4 (RIGHT): Measures 381-386 from the autograph manuscript of Alexander Scriabin's **Prometheus the Poem of Fire** (1911). The color part for a **Tastiera per Luce** appears at the top of the orchestral score. An additional voice was added to this part in the published version.



trackers to a corresponding set of diaphragms in front of special lenses. Stops were furnished to control the three variables of color perception: hue, luminosity, and chroma or color purity. One stop allowed the performer to spread the spectrum band over the entire keyboard instead of one octave – proof of Rimington's flexible attitude concerning the analogy between particular colors and tones. Like all earlier mechanisms (with the exception of Kastner's pyrophone), Rimington's instrument was not capable of producing any sounds. He did recommend, however, that compositions played in color be performed simultaneously on sound-producing instruments because this added to the enjoyment of the color. No new notational system was needed because musical compositions were played on the keyboard in a normal manner and thereby "translated" into colored light.

Rimington's efforts attracted considerable attention. According to a report in the **Musical Courier** (8 June 1895), Sir Arthur Sullivan improvised on the Colour-Organ shortly after its completion. He played with his eyes closed however. On 6 June 1895, Rimington presented a private lecture-demonstration in London which was attended by over a thousand people. His Colour- Organ was accompanied by piano, a normal sound-producing organ, and a full orchestra. It is interesting that this is the same instrumentation called for in Alexander Scriabin's famous 1911 color-symphony, **Prometheus** (Fig. 4). Scriabin probably knew of Rimington's work, and he was the first composer to include a part for projected light – his *Tastiera per luce* – in a score for orchestra. Four subsequent public concerts were given by Rimington in 1895 in which compositions by Wagner, Chopin, Bach, and Dvorak were performed. There were apparently no other presentations until after Rimington published his book in 1911. Sir Henry Wood contacted the inventor in 1914 concerning a proposed realization of the color part in Scriabin's **Prometheus**, but World War I prevented implementation of the performance, and another attempt to produce this work with colored lighting was not undertaken in England until 1972.

Our account of the history of color instruments will continue into the modern era with the author's "Famous 20th Century Color Organs" set to appear in EMI's coming November issue.

A version of these articles was originally published in **Leonardo** vol. 21, no. 4, pp. 397-406 (1988).

Fuller referencing and footnoting appears in the 1988 **Leonardo** version of the articles. **Leonardo** is available from 2030 Addison St., Suite 400, Berkeley CA 94704.

Ken Peacock teaches at New York University, where he directs the Computer Music Technology program. He believes that even in our own century, there's a bright future for innovative color organs.

CONJOINED STRING SYSTEMS: MORE REPORTS FROM BUILDERS

by Jeff Kassel, Tom Nunn and Bart Hopkin

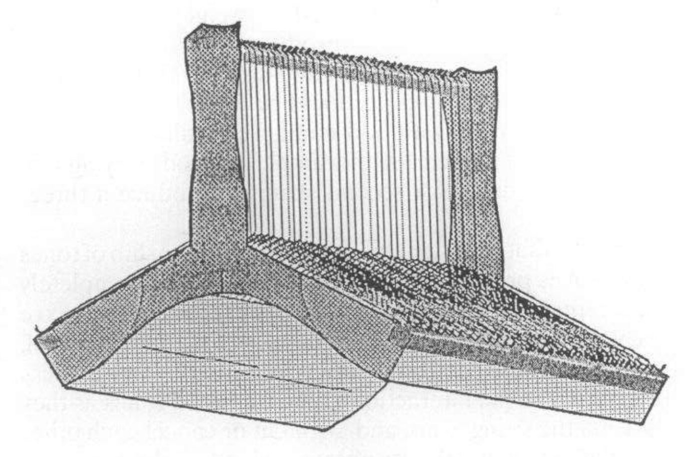
Last April Experimental Musical Instruments *presented an article called "Conjoined String Systems." It discussed what happens acoustically when sets of two or more musical strings, rather than being anchored separately, are attached directly to one another, creating multiple-string vibrating systems. In June, following that first article, we presented reports from Mario van Horrick and Paul Pannhuysen, two builders who have explored such methods in connection with very long strings. Now, in our final installment, we have accounts from three builders who have worked in conjoined string systems at standard string lengths, to produce more conventionally playable instruments.*

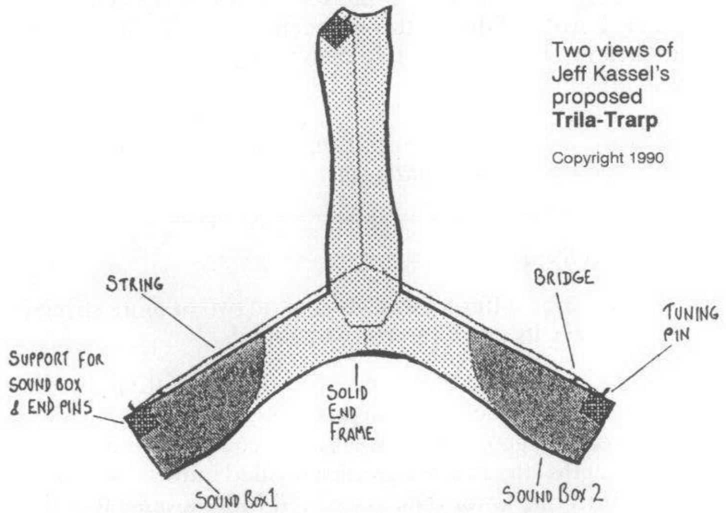
JEFF KASSEL

My first ideas about three-stringed instruments came more from a visual aesthetic and appreciation of geometry than any strong musical grounding. Musicality followed geometry, function following form. This is also true of other instruments, but perhaps less by intention than circumstance. I wanted the musical relations to follow the complexity and limitations of the instrument's basic form. My original three-stringed instrument, the **Tritar** was designed and built with a perfectly symmetrical string arrangement, with all three "rays" of the star equally angled from each other (120 degrees) and, by default, with equal tensioning. This arrangement also makes possible the use of parallel string courses, allowing a more compact and easily playable design. I plan to carry over this rigidity of symmetry to my planned harp-style **Trila-Trarp**, though I will use movable bridges on two out of three string ends to allow some tailoring of tones.

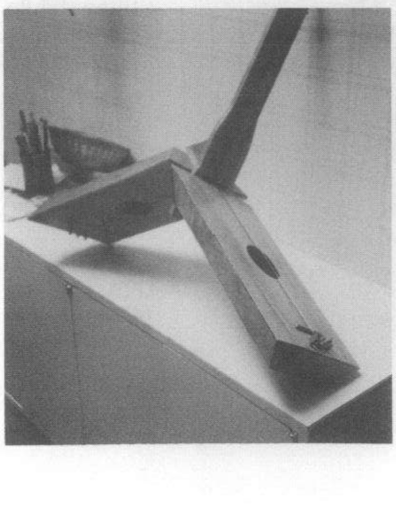
The geometric genesis of my three-string design came from a basic progression in geometry that two points define a one-dimensional line, three define a two-dimensional plane, and four define a three-dimensional space. A conventional musical string is anchored at two ends, defining a single dimension. Most of its vibration occurs in the other two dimensions perpendicular to the string's length. For a three-string (I prefer to think of it as a single string with three ends), anchored at three points, most vibration will occur in the single dimension perpendicular to the plane of the strings. A string with four ends not all on the same plane would limit vibration in all three conventional dimensions, and would presumably only be audible to higher dimension concert-goers. Of course, in practice due to the elasticity of the string material, there is vibration in all three dimensions no matter how many strings are attached. However, the vibration will be significantly damped in all but the "free" dimensions.

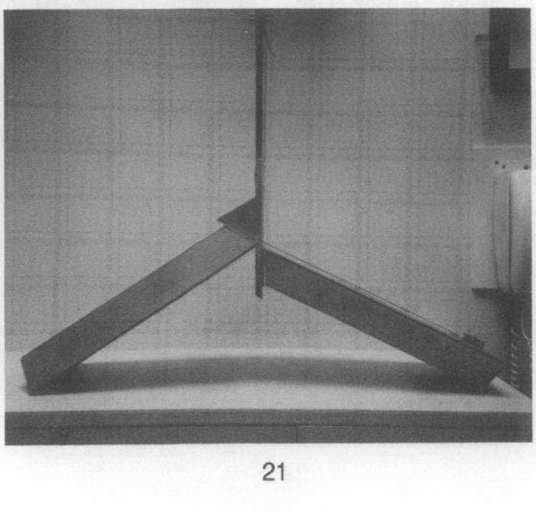
It is possible to attach more than three strings all in the same plane, and still have relatively free vibration in one dimension. As one adds more and more strings in a single plane, one begins to have something that resembles and sounds like a membranophone rather than a chordophone; that is to say, a drum. This brings up another limitation of multi-strings; that when one attaches more





Two views of Jeff Kassel's proposed **Trila-Trarp**





LEFT: Two views of Jeff Kassel's **Tritar**, showing the unusual arrangement of strings and soundboards to accompdate the symmetrical 3-string arrangement.

than one string together, their attachment point or node acts as a barrier, bouncing back much of the vibration rather than transmitting it to the other string arms. Ideally, if one wants to maximize transmission, one needs as weightless a node as possible. This is difficult to produce with a three-string (easier with any even-numbered multi-string). However, with special winding techniques, it should be feasible to produce a fairly weightless node with odd-numbered multi-strings. Up until now, I have settled for the simple method of tying one string to the middle of a second string to produce a three-string.

One area that I am sketchiest on is the relationship of tones and overtones produced by a three-string. With a completely symmetrical arrangement, the tones themselves are presumably simple arithmetic harmonics of the fundamental. I suspect that the special timbre that these instruments possess is due mostly to the interaction of these related tones as they meet from the string arms, and augment or cancel each other depending on their relative phases. Many of the tones are rather short-lived due to this interaction. Again, these ideas are sketchy. A spectrographic analysis over decay time would be interesting.

Jeff Kassel is a biotechnologist trying to figure out how to clone instruments instead of building them.

TOM NUNN

I know of three different ways to conjoin two or more strings, each creating its own characteristic sound.

1) A set of 5 parallel strings with a knitting needle (aluminum) threaded through them, over-under-over-under-over, creates a gong whose tones are a compilation of the 10 string lengths (the five strings each divided into two sections) and at least one lower tone associated with movement of the whole system including the weight of the needle. Once threaded into the strings, the needle can be struck with another knitting needle, making gong-like sounds. There are many tones ringing together, and they're usually prominent in the extreme upper and lower register. All of the tones can be changed by moving the needle, either "in and out" (away from/toward the player if the strings are running left to right before the player) or left/right (i.e., changing string segment lengths). Changing the extent to which the needle overhangs on one side of the strings (normally the side toward the player) changes the effective weight of the needle (by altering its leverage), and thus affects the lowest, whole-system tones. Changing the string lengths by sliding the needle left or right changes tones in the middle and upper registers.

If the needle is not threaded over the last string, but rather allowed to rest beneath the last string (i.e., the last string is "open" because the needle is not touching it), then the needle can be "plucked" (pulled downward and let go), creating a fast, periodic tapping of the needle tip against the open last string. The other four strings then function as an elastic suspension mechanism for the needle. The needle, so plucked, can continue flapping and tapping for more than a minute if the strings are equidistant from the soundboard and the needle is of sufficient length and weight.

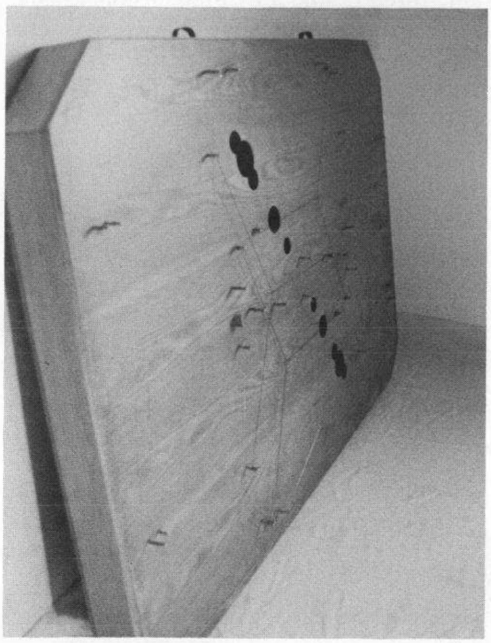
2) A pair of parallel strings with a conjoining, movable bridge, such as a washer, through the center of which both strings pass. This creates essentially five fundamental tones: the four string lengths and the pitch of the whole system, which depends on tension, mass, etc. The neat thing about this type of conjunction is the ability to slide the conjoining bridge up and down the strings. But if the washer (bridge) is held with the fingers, all of the tones are dampened considerably. Any small object with two parallel holes though it could work as a conjoining, movable bridge. But the distance between the holes must not equal the distance between the strings without the bridge (obviously, if they were the same the bridge would create no tension on the strings and just rattle).

3) Same as above, except instead of a washer, the pair of strings is conjoined by a shallow, cone-like radiator. This is something I saw once on a sound sculpture in a redwood burl store somewhere in Northern California. It is an idea I've yet to pursue, but one with plenty of potential! The radiator/bridge acoustically amplifies the strings, of course, augmenting the sound from the body of the instrument to which the strings are attached. The radiator/bridge is movable, just like the washer in #2 above. When one of the strings was plucked, you could hear all of the string segments in the tone, though the one plucked was stronger. In this type of arrangement, if I remember correctly, there is no audible low bass tone representing the pitch of the whole system. Presumably the relatively large mass of the radiator/bridge (about a 3-inch diameter cone, maybe weighing half a pound) was enough to make the whole system fundamental subsonic. But it made itself heard in another form none-the-less: plucking one of the four string lengths would cause the whole system to oscillate back and forth creating a vibrato at the frequency of the subsonic fundamental! Pretty neat.

Tom Nunn is a musical instrument designer, composer and improvisor living in San Francisco.

BART HOPKIN

The photograph below shows my instrument called Trillium Cluster. A 4' x 5' x 4" deep sound chamber and soundboard supports twelve three-string systems, each presenting its own range of melodic and timbral/harmonic possibilities. Composition for trillium cluster works like this: I take the time to create a tuning I like. This involves an interplay between repeatedly plucking, adjusting string tensions and



LEFT: **Trillium Cluster**, with its 12 three-string systems arrayed on a large soundboard.

listening, and going back and forth between the twelve systems, seeking out relationships that appeal to me and casting off those that don't. I do this until I'm satisfied with the harmonic relationships I've created throughout the twelve systems on the instruments. Once done, the tuning, with its inherent possibilities, essentially is the composition. The composition is realized when someone improvises within the tuning. In playing the thing, I often use a steel slide, bottleneck style, to play melodically – which inevitably means harmonically as well – on the individual clusters, and to take advantage of the three-strings' remarkable sliding effects. Pressing the steel against one of the strings at a chosen stopping point and varying the pressure, thus pressing the string down and varying the tension in the system, also creates striking melodic, harmonic and timbral effects.

Bart Hopkin is editor of **Experimental Musical Instruments.**

NOTICES

Now available: Xenharmonikon Nos. 7-13, cassette by experimental Indonesian composer I Wayan Sudra. Soon to be published: John Chalmers' **Divisions of the Tetrachord**. Write for complete catalogs. Frog Peak Music and American Gamelan Institute, Box A-36, Hanover, NH 03755.

WANTED: NAMES AND ADDRESSES of collectors and institutions with collections of musical instruments for new, revised editions of the **International Directory of Musical Instrument Collections** and the **Survey of Musical Instrument Collections in the United States and Canada.** An information form will be sent to the names received. Send names and addresses of collections everywhere except the US and Canada to the general editor of the international directory: Barbara Lambert, 201 Virginia Rd., Concord, MA 01742 USA. Information on North American collections to: William E. Hettrick, Music Dept., Hofstra University, Hempstead, NY 11550.

MUSIC FROM BOB GRAWI'S GRAVIKORD – the electric double harp based on the African kora (EMI 2/88); Cassettes: "Making Waves" (solo), "Rising Tide" (ensemble with flute, bassoon and percussion) $11; "Rising Tide" CD, $17, includes shipping. For information or orders write: White Bear Enterprises, PO Box 106, Florida, NY 10921.

AT LAST, it is ready. For $7 you can have your very own copy of A DECADE OF DEBRIS by MUSIC FOR HOMEMADE INSTRUMENTS. Includes compositions by MFHI members Alice Eve Cohen, Geoffrey Gordon, Rolf Groesbeck, Skip La Plante and David Simons. The less fanatic among us have used clarinet, bass violin and ordinary drums in places; therefore, it is true that most of this music is played on our loft full of New York City trash reincarnated as instruments. MUSIC FOR HOMEMADE INSTRUMENTS, 262 the Bowery, NY,NY 10012

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BITTER MUSIC: Collected Journals, Essays, Introductions, and Librettos, by Harry Partch, edited by Thomas McGeary. New from University of Illinois Press, P.O. Box 4856, Hampden Post Office, Baltimore, MD 21211, Toll-Free phone orders (US only) 1-800-545-4703 (mention code IPB), Maryland customers: (301)338-6927

Francisco López, sound artist working in the field of environmental sound, is interested in tape exchanges with others working in the same area. For a copy of his exchange catalog, write him at Apartado 2542, 28080, Madrid, Spain.

SPIRIT OF INVENTION: An exhibit/performance with original instruments & their builders. August 24, 1991. Exhibit 11 AM - 5 PM; performance 8 PM. STUDIO P.M., 455A Valencia St., San Francisco, CA.

Very attractive WM 28, sensuous, sexy, slim, looks great in tuxedo but prefers jeans & cowboy boots seeks wealthy, generous, attractive lady for lasting, extremely discreet friendship. Age/race insignificant. #357, POB 5553 MV.

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Experimental Sound Studio is a non-profit organization for the production and promotion of innovative sonic arts. ESS has studio facilities and several other programs for members. New from ESS: **Sounds From Chicago**, a curated series of 23 half-hour radio programs featuring audio art, poetry, improvisational music, world music, performance art and more. Heard on several radio stations, and available free to broadcasters. ESS, 5150 N Paulina, Chicago, IL 60640 (312) 784-0449.

For sale or rent: One slightly used Italian. All parts in good working order. Not real good looking, but lots of fun. Looking for woman to work on farm. Must have tractor. Would like to see the tractor first. #50097, POB 1829 MV.

RESIDENCIES AT HEADLANDS CENTER FOR THE ARTS: Headlands Center, located in the Golden Gate National Recreation Area just north of San Francisco, is taking applications for their Artist in Residency program, which includes both visual and sound artists. Application deadline August 23, 1991. Contact Headlands Center for the Arts, 944 Fort Barry, Sausalito CA 94965; phone 415/331-2787.

WHERE SAWS SING AND FIDDLES BLOOM: A 60 minute cassette of duet improvisations by Hal Rammel and Johannes Bermark on musical saws, waterphone, melodica, and various instruments designed and constructed by Hal Rammel. Write: Cloud Eight Audio, 1622 W. Sherwin, Suite 2S, Chicago, IL 60626.

JUST INTONATION CALCULATOR by Robert Rich and Carter Sholz. A composer's tool for just intonation. Internal sound for tuning reference; microtonal ear training; shows modulations; reduces fractions; converts between ratios, cents, and Yamaha tuning units; MIDI tuning dumps for many brands of synthesizers. Requires Macintosh with Hypercard -- only $10.00. Soundscape Productions, Box 8891, Stanford, CA 94309.

EMI BACK ISSUES: Back issues of **Experimental Musical Instruments** numbered Volume VI #1 and later are individually available for $3.50 apiece. Earlier issues are available in volume sets of 6 issues each, photocopied and spiral bound: Volumes I through V, $14 per volume. Order from EMI, PO Box 784, Nicasio, CA 94946, or write for complete listing. Corresponding cassette tapes also available for each volume; see information below.

CASSETTE TAPES FROM EMI: **Our new tape, From the Pages of Experimental Musical Instruments**, Volume VI, is now available later this month, and we are taking orders now. Its predecessors, Volumes I - V are also still available. Prices are $6 per volume for subscribers; $8.50 for non-subscribers (each volume is one cassette). Each tape contains music of instruments that appeared in the newsletter during the corresponding volume year, comprising a full measure of odd, provocative, funny and beautiful music. Order from EMI, Box 784, Nicasio, CA 94946.

MICROTONAL MIDI TERMINAL (vers. 1.2) by Denny Genovese lets you play nearly any MIDI synthesizer in Just Intonation! A veritable "tuning processor" as well, it has many features for constructing, editing, transposing, analyzing and printing Just Scales. Tuning data is shown in Ratios, Cents, Frequencies and Yamaha TU's. Those without a MIDI instrument can hear the Just scales on the computer's built in speaker. Holds 16 scales in memory, which are selected by single keystrokes. Tunings may be transposed into any key with another quick stroke. Requires IBM XT/AT or compatible and, for performance, an MPU-401 or compatible MIDI interface. $60 from DENNYS SOUND & LIGHT PO Box 12231 Sarasota, FL 34278.

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The following selected list contains articles relating to unusual musical instruments which have appeared recently in other publications.

"Alvin Lucier's Recent Music" by Eric de Visscher, in **Logos-Blad** 13 #4, April 1991 (Kongostraat 35, 9000 Gent, Belgium).

A discussion of Lucier's most recent works. Lucier's pieces are unadorned explorations of acoustic phenomena, mixing an approach somewhat akin to laboratory experimentation with a finely honed aesthetic awareness. Despite the convenience of electronics for this sort of work, Lucier has in recent pieces moved increasingly toward exclusive use of acoustic sound sources.

"A Visual Window to Tone Production" by Norman Weinberg, in **Percussive Notes** Vol. 29 #5, June 1991 (Box 697, 123 W. Main St., Urbana, IL 61801-0697).

The author used Digidesign's *Sound Designer* and Passport's *Alchemy* in conjunction with a sampler and a Mac SE computer to perform comparative spectral analyses on several standard percussion sounds (a triangle struck in various ways, a cymbal struck in various ways, and woodblocks from a couple of manufacturers.) The real performers here are the software, with their fascinating and highly readable graphic representations of spectral changes over time in several formats. When're they going to come up with something like this for IBM?

"Drawing with Sound" by Karen Wolff, in **Leonardo** Vol. 24 #1, 1991 (2030 Addison St., Suite 400, Berkeley, CA 94704).

The author describes her work in creating convincing impressions of moving sound sources using signals panned through multiple speakers arranged in a space. Drawing on experience with many such installations, she has designed a flexible, practical and reasonably portable control console + remote speakers arrangement for designing and realizing moving sound installations. The article contains a body of practical information, gleaned from experience, on what works well and what does not given the nature of moving sound perception.

"A Low Cost Bass, Part 2" by Frederick C. Lyman, Jr, in **American Lutherie** Number 25/Spring 1991 (8222 South Park Ave., Tacoma, WA 98408).

This is the conclusion of a report on the creation of a reasonably playable bass viol from plywood and other inexpensive, commonly available materials.

"26 Chord Bars – 25 Years Ago" by Blaine F. Jaeger, and "TimbreHarps: Luthiers Randy Barnes and Mitch Pingel" by Becky Blackley, both in **Autoharpoholic** (Box 504, Brisbane, CA 94005).

These two articles discuss aspects of autoharp design and construction, one from an amateur's point of view and the other from that of an established maker.

"Aircraft Overflight Study" by Paul Matzner, also in **Nature Sounds** (address above).

The article provides information on the progress of studies being conducted by the U.S. National Park Service to collect data and recommend policy on noise pollution effects of aircraft flights over natural areas. The author encourages people concerned with natural sound and quietude to express support for the idea of noise management in natural areas, and provides addresses & phone numbers for speaking to the coordinators and getting on the mailings lists for the studies.

"Modulus Graphite Expands Facility as Demand Grows", in **Music Trades** May 1991 (80 West St., PO Box 432, Englewood, NJ 07631).

The founder of Modulus Graphite, Inc., which makes graphite products for aerospace applications, patented a graphite guitar neck in 1977 and has been making graphite-neck guitars & bass guitars of extraordinary rigidity and stability since then.

"UMI's Hi-Tech Horn Making", also in **The Music Trades** (address above).

This article looks at recent advances in computer-controlled manufacturing techniques for woodwind and brass instruments at United Musical Instruments, the parent company of Artley, Armstrong, Benge, Conn, King, and Scherl & Roth. Included along with the highly informative text are photographs of computer-controlled robotic production machinery.

Ear Magazine Volume 19 #2 (131 Varrick St. Room 905, New York, NY 10013) has a special focus on environmental music. See the commentary appearing in the letters section of this issue of EMI.

CAS Journal (Journal of the Catgut Acoustical Society) has made its semiannual appearing with the May 1991 issue (112 Essex Ave., Montclair, NJ 07042). Included are articles on violin plate tuning, development of objective parameters for measuring quality in violins, tests of the effects of varnishes on spruce, acoustical properties of Australian woods, aging of nylon strings, and several shorter pieces.

The book reviews section of **Ethnomusicology** Vol. 35 #1, winter 1991 (Morrison Hall 005, Indiana University, Bloomington IN 47405) contains discussions of several new books on musical instruments, including:

Les Instruments de Musique du Rwanda: Etude Ethnomusicologique by Jos Gansemans (Tervuren, Belgium: Royal Museum of Central Africa, 1988) – a comprehensive study of the musical instruments of Rwanda;

Instruments and the Electronic Age: Toward a Terminology for a Unified Description of Playing Technique by Tellef Kvifte (Oslo: Solem Forlag, 1988) – yet another stab at creating a comprehensive classification scheme for musical instruments (there have been many over the years), this one emphasizing playing technique/control mechanisms;

Stringed Instruments of Ancient Greece by Martha Maas & Jane Snyder (New Haven: Yale U Press, 1989) – a beautifully documented compendium of surviving pictorial and literary evidence; and

Korean Musical Instruments: a Practical Guide by Kieth Howard (Seoul: Se-Kwang Music Publishing Co., 1988) – an in-depth study of several representative Korean instrument types, in which **Ethnomusicology**'s reviewer finds many shortcomings.